CHAPTER III

METHODOLOGY

A. Research Method and Research Design

1. Research Method

The study applied descriptive research method to the use of concept map as assessment tool on urinary system. According to Best, descriptive research is concerned with how or what is exists related to some preceding event that has affected a present condition or event (Cohen et al., 2007). In this research, data was gathered by conducting paper and pencil test and concept map scoring. The score of students' paper and pencil test and concept map were analysed and used to find the correlation between two variables.

2. Research Design

In this research correlation design is used. According to Gay, Mills and Airasian (2009) correlation research involves collecting data to determine whether, and to what degree a relation exist between two or more quantifiable variable.

B. Population and Sample

1. Research Location and Period

The location of this research is International Junior High School in Bandung in the School period of 2014/2015. This school uses English as the formal language of instruction and applies Cambridge Curriculum in combined with National Curriculum and their own curriculum. This school mostly combines Cambridge and National Curriculum for science subject.

2. Population and Sample

The population of this research was all 8^{th} grade students. The samples are 26 students in from 8^{th} grade. The sampling technique that implemented is convenience sampling or accidental sampling. Gay, Mills and Airasian (2009) stated that convenience sampling is the process of including whoever happen to be avilable at the time.

C. Operational Definition

In order to avoid misconception about this research, some operational definition is explained. Those terminologies are explained as follow:

1. Definition of concept map is a visual representation of the relationships between concepts held by an individual, materials of a lecture, textbook, or laboratory exercise. In conducting learning process, concept map is constructed manually by student in a piece of paper. The score of student's concept map was gathered as data. Concept map would be scored by Mueller's Classroom Concept Map Rubric that has four aspect of assessment: legibility, accuracy, completeness and sophistication.
2. Paper and pencil test was constructed by 20 multiple choice question and four essay questions. Multiple choice questions were constructed by cognitive domain C1 until C5 while essay question construct by C3 until C6 cognitive process. Paper and pencil instrument will be testing its validity by expert judgement and ANATES. Essay item test was scored based on the indicator. The score of multiple choice and essay objective test were then combined and use as the data.
3. Cognitive that is being measured in this research involves level of cognitive remembering (C1), understanding (C2), applying (C3), analysing (C4), evaluating (C5) and creating (C6) based on Taxonomy Bloom from Anderson (2001). This competence is measured by using multiple choice and essay question of paper and pencil test.

D. Research Instrument

In this research, instrument is necessary to be used for gaining data. There are two type of instrument that is used in this research. Those instruments are described below.

1. Objective and subjective test is used as an evaluation to measure the students' cognitive after learning urinary system.
2. Concept map rubric is proposed to determine the score of students' concept map.

3. Guidance of interview is purpose to guide in collecting data through interview.

1. Design of Research Instrument

a. Objective and Subjetive Test Instrument

Objective test is in a form of multiple-choice questions. This objective test is used to see student cognitive after learning urinary system concept. There are six cognitive process that used in multiple-choice and essay questions; there are remembering (C1), understanding (C2), applying (C3), analysing (C4), evaluating (C5) and creating (C6). Multiple choice questions consist of five cognitive domains remembering (C1), understanding (C2), applying (C3), analysing (C4), and evaluating (C5). While essay question consist of four cognitive domains applying (C3), analysing (C4), evaluating (C5), and creating (C6).

All of the test item has been judged by experts and then analysed using ANATES statistical software after tested to 9th grade students. The result of the test items after tried out was used, revised or deleted. The blueprint of objective question before conducting instrument analysis is shown in Table 3.1 and 3.2.

Table 3.1 Blueprint of Multiple Choice Test Items before Validation.

Topic	Cognitive Process					∑	%
	C1	C2	C3	C4	C5		
Structure	3, 7, 8	13, 14, 21	-	-	-	6	14.6
Function	1, 4	5, 6, 9, 11	-	36	-	7	17.0
Urination Process	-	12, 18	25	29, 32, 34, 35	-	7	17.0
Urine Formation	-	2, 10, 15, 16, 17, 19, 20	-	33, 37	38	10	24.4
Disease	-	-	22, 23, 24, 26, 27	28, 30, 31	39, 40, 41	11	26.8
Sum	5	16	6	10	4	41	100

Table 3.2 Blueprint of Essay Test Items before Validation.

Topic	Cognitive Process				∑	%
	C3	C4	C5	C6		
Structure	-	-	-	-	0	0
Function	-	-	-	-	0	0
Urination Process	-	-		-	0	0
Urine Formation	-	2	3	-	2	50
Disease in Urinary System	1	-	-	4	2	50
Sum	1	1	1	1	4	100

After conducting instrument analysis, new blueprint of objective test is gained and used as research instrument. The result of research analysis is attached in appendix. From 41 questions that have been judged and revised 20 questions are used. While for essay item test from four questions, all of them are used and revised. The blue prints of test items after instrument analyses are shown in the Table 3.3 and 3.4.

Table 3.3 Blueprint of Multiple Choice Test Items after Validation.

Topic	Cognitive Process					∑	%
	C1	C2	C3	C4	C5		
Structure	2,6	8,11				4	20
Function	1	3				2	10
Urination Process		4,17	10, 13			4	20
Urine Formation		5,7,9		18		4	20
Disease in Urinary System		19	12,14	15,16	20	6	30
Sum	3	9	4	3	1	20	100

Table 3.4 Blueprint of Essay Objectives Test Items after Validation.

Topic	Cognitive Process				∑	%
	C3	C4	C5	C6		
Structure	-	-	-	-	0	0
Function	-	-	-	-	0	0
Urination Process	-	-		-	0	0
Urine Formation	-	2	3	-	2	50
Disease in Urinary System	1	-	-	4	2	50
Sum	1	1	1	1	4	100

b. Rubric

Rubric scale is used to analyse the concept map that made by the student. This rubric scale will determine whether student is able to make a good concept map or not. The rubric is based on Mueller's Classroom Concept Map Rubric.

Table 3.5 Table of Mueller's Classroom Concept Map Rubric.

Legible easy to read and free of spelling errors	No (0-1)		Yes (2)	
Accurate concepts used accurately	Many inaccuracies (0-2)		A few inaccuracies (3-4)	No inaccuracies (5)
Complete sufficient number of relevant concepts and relationships	Limited use of concepts /relationship (0-2)		Some use of concepts and/or relationships (3-4)	Sufficient number of concepts and relationships (5)
Sophisticated finding meaningful connections between relevant concepts	Little or none (0-1)	Few meaningful connections made (2-4)	Some meaningful connections made (5-7)	Meaningful and original insights demonstrated (8)

c. Interview Guidance

Interview guidance is used to guide the process of interview while obtaining data. The interview is done after data of concept map and paper pencil test was obtained. The interview was regarding about students impression in constructing concept map and doing paper and pencil test.

2. Instrument Analysis

The objective test instrument is used to measure student's cognitive. The analysis of instrument will be covers validity, discriminating power, level of difficulty, and reliability.

a. Validity

Validity is defined as the extent to which the instrument measures what it is designed to measure that emphasize on not on the test itself, but on the result (Arikunto, 2003). According to Arikunto (2003) to get valid result of the activity, the instrument that will be used must be valid. The validity that will be used is construct validity. Construct validity is used

because the instrument will be design to measure student cognitive based on learning objective. To determine the number of validity, it is done with the product moment correlation equation as follows.

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

Where,

r_{xy} = items correlation coefficient.

$\sum$ x = sum of total score of all student for each question's item.

$\sum$ y=sum of total scoreof all students for whole test.

Y = total score of each student.

X = items scores.

N = amount of subject.

(Arikunto, 2003)

Table 3.6 Validity Interpretation

Correlation Coefficient	Validity Criteria
0,80 < r ≤ 1,00	Very high
0,60 < r ≤ 0,80	High
0,40 < r ≤ 0,60	Enough
0,20 < r ≤ 0,40	Low
0,00 ≤ r ≤ 0,20	Very low

(Minium, et.al., 1993)

b. Reliability

Reliability is a measurement, which stated about consistence of the measurement tools that used. Reliability is defined as the extent to which an instrument produce the same result on repeated trials. Reliability tends to a definition about trust instrument that is used as collecting data tools. To define the reliability of objective test, alpha formula will be used as a formula because the question using multiple question (Arikunto, 2003)..

$$r_{11} = \left[\frac{n}{n-1}\right]\left[1 - \frac{\sum \sigma_i^2}{\sigma_i^2}\right]$$

Where,

r_{11} : Instrument reliability

n : Amount of question

$\sum \sigma_i^2$: Amount of variant score in each item

σ_i^2 : Varian total

(Arikunto, 2003)

Table 3.7 Reliability Interpretation

Correlation Coefficient	Reliability Criteria
0,80 < r ≤ 1,00	Very high
0,60 < r ≤ 0,80	High
0,40 < r ≤ 0,60	Enough
0,20 < r ≤ 0,40	Low
0,00 ≤ r ≤ 0,20	Very low

(Arikunto, 2003)

c. Difficulty Level

Too much difficult question will not good for student because it can make student depressed and do not motivated to solve the problem. The good question is the question that has easy, medium and difficult item on it.

To show the difficulty level of the question, difficulty index can be used to show the difficulty level of question. The range of level of difficulty is from 0,00 to 1,00. The lower the index then the question is more difficult and vice versa. To find out the difficulty index the formula that is used is shown below:

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

Where,

P =Difficulty index

B =Number of students who answer the question correctly

JS = Number of all students who join the test

(Arikunto, 2003)

Table 3.8 Difficulty Level

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

(Arikunto, 2003)

d. Discriminating power

Decimating power is define as ability of particular question to distinguish student who classified as higher achiever and lower achiever the amount of higher achievement student compared to lower achievement student means that those question have positive discriminating power index (Arikunto, 2003). Discriminating power index show the scale from minus one until positive one, with the negative one represent the lower discriminating power index. The formula is represented below.

$$DP = \frac{Ba}{Ja} - \frac{Bb}{Jb}$$

Where:

DP= discriminating power

Ba= the number of upper group that answer correctly

Ja= total of student in upper group

Bb= the number of upper group that answer incorrectly

Jb= total of student in lower group

(Arikunto, 2003)

Table 3.9 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, 2003)*

e. Distractor

In multiple choice item tests, there is one right answer and the other option is wrong answer. This wrong answer is made

to make student attract to that option. In determining whether the distractor is good or no, we use this formula.

$$\frac{\text{Total of student who choose the option}}{total\ of\ student\ who\ do\ the\ test} x\ 100\%$$

(Arikunto, 2003)

The summary of all instrument data analysis is displayed in Table 3.10.

Table 3.10 Summary of Instrument Data Analysis Result

MULTIPLE CHOICE OBJECTIVE TEST						
No	New Number	Discriminating Power (%)	Difficulty Index	Validity		Decision
				Value	Significant	
1	1	0.00	Medium	0.244	-	Used with revision
2		-28.57	Medium	-0.033	-	
3	2	14.29	Easy	0.216	-	Used with revision
4		00.00	Very easy	-0.007	-	
5		14.29	Very easy	0.213	-	
6		-14.29	Medium	0.124	-	
7	3	14.29	Very easy	0.161	-	Used with revision
8		00.00	Very easy	NAN	NAN	
9		14.29	Easy	0.255	-	
10		-14.29	Difficult	-0.223	-	
11	4	14.29	Very easy	0.296	Significant	Used
12	5	42.86	Medium	0.311	Significant	Used
13	8	57.14	Medium	0.493	Very Significant	Used
14		-14.29	Very difficult	-0.236	-	
15	9	28.57	Very Easy	0.456	Very Significant	Used
16	6	28.57	Very Easy	0.296	Significant	Used
17	7	28.57	Very Easy	0.362	Very Significant	used
18	10	14.29	Very Easy	0.161	-	Used with revision
19		14.29	Easy	0.238	-	
20		28.57	Difficult	0.077	-	
21	11	57.14	Very easy	0.568	Very significant	Used
22		57.14	Easy	0.542	Very significant	

No	New Number	Discriminating Power (%)	Difficulty Index	Validity		Decision
				Value	Significant	
23		0.00	Medium	-0.221	-	
24	12	42.86	Easy	0.326	Significant	Used
25	13	14.29	Very difficult	0.384	Very significant	Used
26	14	57.14	Medium	0.421	Very significant	Used
27		42.86	Easy	0.312	Significant	
28	15	85.71	Medium	0.528	Very significant	Used
29		28.57	Difficult	-0.040	-	
30	16	57.14	Medium	0.548	Very significant	Used
31		100.00	Medium	0.714	Very significant	
32	17	28.57	Very easy	0.290	Significant	Used
33		71.43	Medium	0.573	Very significant	
34	18	14.29	Medium	0.293	Significant	Used
35		-42.86	Medium	-0.351	-	
36	19	42.86	Medium	0.330	Significant	Used
37		57.14	Medium	0.516	Very significant	
38		42.86	Easy	0.409	Very significant	
39	20	57.14	Easy	0.542	Very significant	Used
40		-14.29	Medium	0.049	-	
41		28.57	Medium	0.129	-	
ESSAY OBJECTIVE TEST						
No	New Number	Discriminating Power (%)	Difficulty Index	Validity		Decision
				Value	Significant	
1	1	83.33	Medium	0.797	Very significant	Used
2	2	50.00	Medium	0.808	Very significant	Used
3	3	12.50	Medium	0.325	-	Used with revision
4	4	5.56	Medium	0.000	-	Used with revision

E. Data Analysis

In this research the data is processed in quantitatively and supported by qualitative data. Quantitative data processing is used for measuring both students' paper pencil and concept map.

1. Quantitative Data Analysis

Quantitative data analysis is done by Microsoft excel and SPSS calculation, in order to determine the score of pre-test and post-test. Then the result of the data will be processes as the following explanation.

a. Scoring test items

The first step to process data is scoring the test items. The test items are provided in the 20 number of multiple choice questions and four essay questions. The result will be scored, and the scores were processed using Microsoft excel. . Full score of multiple choice will be 20 while essay 30. To determine the final score of objective test as follow.

$$\frac{score\ of\ multiple\ choice + score\ of\ essay}{5}$$

b. Scoring Concept Map

The second step is to process the scoring of student's concept map. Student's concept map is cored based on Mueller's Classroom Concept Map Rubric. The scoring aspect is about the legibility, accuracy of concept used, the completeness of concept and the relation between every concept. The scores are processed using SPSS statistic 19.

$$\frac{legibility + accuracy + completeness + sophistication}{2}$$

c. Normality Test

Normality test is use to know whether the sample comes from population that has normal distribution or not (Ghasemi and Zahediasl, 2012). In this research, Normality test is used statistic test from SPSS 19 with significance level (α) is 0,05.

d. Determining the Correlation Coefficient

Determining the correlation coefficient is needed to analyse whether or not there is correlation between students' paper pencil test and concept map. The analysing process is using non parametric statistic Spearman rank correlation. According to Simon and Goes (2011) Spearman rank correlation can be use to analyse the data that has less than 30 samples. Spearman rank correlation is used if the data at least one variable is an ordinal data (Gay, Mills and Airasian: 2009). According to Simon and Goes (2011) the formula of Spearman rank correlation is:

$$r^s = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)}$$

Where,

r^s = spearman coeficient

d_i =difference in the ranks given to the two variable values

n = amount of data

(Simon and Goes, 2011)

The spearman coefficient then will be interpreted to identify whether or not there is correlation between two variables. One way to interpret the correlation coeficient is shown in Table 3.11.

Table 3.11 Interpreting Correlation Coefficient Chart.

Coeficient	Relation between variable
Between +.35 and -.35	Weak or none
Between +.35 and +.65 or between -.35 and -.65	Moderate
Between +.65 and 1.00 or between -1.00 and -.65	Strong

(Gay, Mills and Airasian: 2009)

Based on figure below, there are three types of association pattern; linear curvilinear and uncorrelated. The linear relation classified into two type's negative and positive linear relation. Positive linear relation is the

relationship of score where the low (or high) the score on one variable relate to how low (or high) score on the other variable (Creswell, 2007).

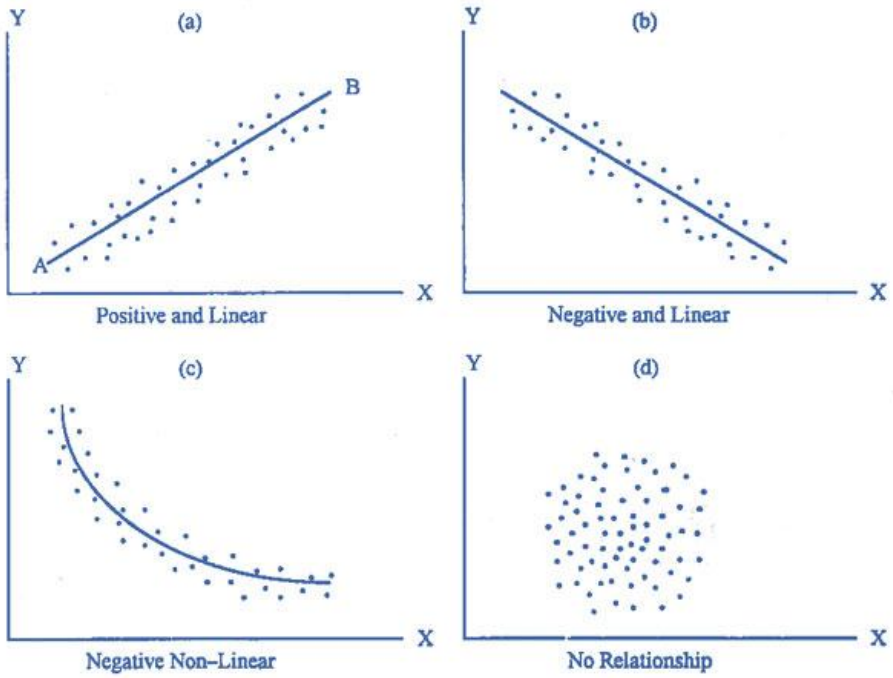

Figure 3.1 Pattern of Association Between Two Variables.

(Source: aqq.auburn.edu)

Creswell (2007) stated that a curvilinear distribution shows increase, plateau, and decline in Y- axis variable with increasing in x– axis variable or increase, plateau, and decline in Y- axis variable with increasing in – axis variable decrease, plateau, and increase in Y- axis variable with increasing in X– axis variable. While no correlation relationship shows the distribution of variables that independent each other. A particular score in one variable does not predict or tells us any information about the possible score on the other variable.

F. Research Procedure

There are three stages of procedure consist of preparation stage, implementation stage and completion stage. Those three stages will be explained as follow.

1. **Preparation Stage**

   In this stage researcher prepare everything that will be needed for the implementation of this research. In this stage, the researcher conduct several stages that support the research, the steps will be explained as follow:

   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 can be taking from compatible resources, such as the latest book, journal, articles, etc.

   b. Choose the topic for implementing research.
   c. Analysing the concept.
   d. Conducting prior study.

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

   e. Determine the research sample.
   f. Construct and justify the instrument.

2. **Implementation Stage**

   a. Administration the instrument.
   b. Take data of student concept map.
   c. Conducting objective test.
   d. Scoring the data of student's paper pencil test and concept map.

3. **Completion stage**

   a. Data analysis.
   b. Draw conclusion.
   c. Give suggestion for further research.
   d. Consult it with the lecture.

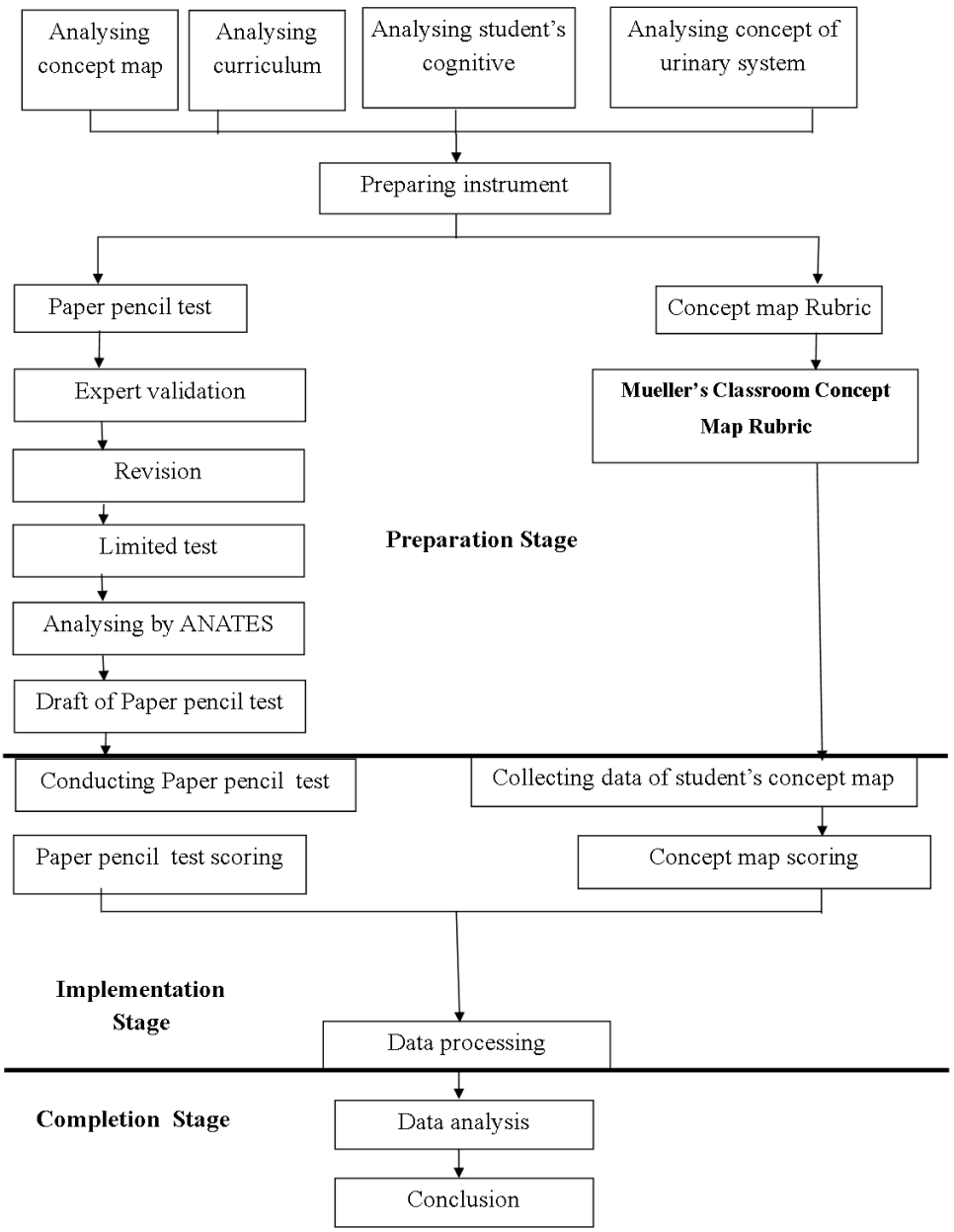

Figure 3.2 Research Procedure