CHAPTER III

METHODOLOGY

A. Research Method and Design

1. Research method

The experimental method used in this study is quasi-experimental, this is due to many variables that cannot be controlled by the researcher. Based on Sukmadinata (2011), the quasi-experimental control is only performed on one dominant variables, one of them is a method of learning. Researcher use experimental research to test the effect of visuo-spatial representation towards student's conceptual mastery. The research carries out two experimental groups of 8^{th} grade students that are girl class and boy class.

2. Research Design

The research design that is used in this research is two grouppre-test and post-test design. It can be called as matching pre-test-post-test comparison group design without control group. Both of class become experiment class by non-random taken a group. Here is the study design matching pre-test-post-test comparison group design are illustrated in Table 3.1 (Sukmadinata, 2011).

Table 3.1 Research Design: Two Group of Pre-test-Post-test Design

Class	Pre-test	Treatment	Post-test
Experiment class of girl	O_1	X	O_2
Experiment class of boy	O_3	X	O_4

O_1 = Pre-test for girl class
O_2 = Post-test for boy class
O_3 = Pre-test for girl class
O_4 = Post-test for boy class
X = Treatment using Visuo-spatial representation using wimba model

(Sukmadinata, 2011)

Both of the classes have the same treatment that is learning design using visuo-spatial representation using wimba model which made of play dough in the concept of Urinary System. Finally the result of both classes is compared in order to see the differences between both classes in improving the conceptual mastery.

B. Population and Sample

1. Research Location and Period

The location of this research is in One of Billingual Boarding School in the School period of 2013/2014.This school is one of the Pasiad partner school which use KTSP curriculum mix with Zambak modular system. This school named as bilingual school because it use Bahasa and English as its instruction language. English is used for delivering science and technology subject, meanwhile Bahasa is used for delivering other rest of subjects. This school is appropriate for this research because it has a different system of class division. The class of girl and boy students are separated. This is why the researcher chooses this school to conduct research of gender differences.

2. Population and Sample

Population of this research is all of student's conceptual mastery that belongs to 8^{th} grade students. The sample is taken from two classes of the 8^{th}grades. There are 8 A and 8 B as different based gender classes. 8 A is boy class and 8 B is boy class, both of them are given the same treatment that is Visual-spatial representation using wimba model which made of play dough.

Sampling are selected by purposive sampling technique according to Fraenkel, *et.al*., (2011). The consideration is because the researcher choose sample

based on the specific purpose which is compare the cognitive achievement between girl and boy students, therefore researcher choose sample from based gender classes (Fraenkel, *et.al.*, 2011). Total samplings are 30 of 8th grade students, with 8 girl students and 21 boy students.

C. Operational Definition

In order to avoid misconception about this research, thus some operational definitions are explained in this research. The terminologies are described as follows.

1. Visuo-spatial representation

   Visuo-spatial representation is one kind of the representation using 3 dimension (3D) modelling. In this research visuo-spatial representation is using wimba model which adapted from Tabrani (2005) and Lazaer (2004). Different from visual representation in 2 dimension (2D), visuo-spatial representation help student to understand the concept in 3D form, thus the object have space. Then the student can learn about the object from many aspects such as its color, form, and texture.

   The wimba model which adopted from Tabrani (2005) used the way of *Extra close* up way. This way take shot of one specific organ or structure in detail in order to make a focus model of the object.

2. Conceptual mastery

   The conceptual mastery of this research, focus on the topic of Human urinary system. It measure how far this visuo-spatial representation using wimba model help student's thinking ability to be able to reach the cognitive domain. This conceptual mastery measured by the objective test, which consisted of multiple choice tests. Where the questions are involving the questions from C1-C4 according to Bloom's Taxonomy cognitive domain are C1 (remembering), C2 (understanding), C3 (applying), and C4 (analyzing).

3. Student Impressions

   Student impression here means the student impression toward the teaching strategy, here is visuo-spatial representation by using wimba model. It measured by notes instrument which provided in the form of *Likert-scale*.

D. Research instrument

The research instrument that used in this research is encompasses several instruments that are:

1. Objective test is used as an evaluation to measure the conceptual mastery of students in the pre-test and post-test.
2. *Likert-scale* as questionnaire is proposes to the treated class, to get response about student's impression toward learning by visuo-spatial representation using play dough.

1. Design of Research Instrument

a) Objective Test Instrument

The objective test is used to evaluate the conceptual mastery of students in learning Human Urinary Chapter through visuo-spatial representation. Conceptual test is multiple-choice with four options with the cognitive domain of C1 (remembering), C2 (understanding), C3 (applying), and C4 (analyzing). Before conducting instrument analysis, objective test consist of 30 test items in the form of multiple choices. This objective test has analyzed using ANATES 4.9.0 statistical software. The blueprint of objective question before conducting instrument analysis is shown in Table 3.2.

Table 3.2Blueprint of Objectives Test Items before Validation

No	Concept	Cognitive Domain				∑	%
		C1	C2	C3	C4		
1	Urinary system	1, 2, 3, 4	6, 7, 8	5	-	8	26.6

No	Concept	Cognitive Domain				∑	%
		C1	C2	C3	C4		
2	Kidney structure	11, 12, 14,	13,	-	-	4	20
3	Mechanism of Urine Formation	15, 17, 18,	10, 16, 22, 24, 28, 29,	9, 19, 21, 30	20, 23, 25, 26, 27,	18	60
Total		10	10	5	5	30	-
Percentage (%)		33.3	33.3	16.6	16.6	-	100

All of the test items are analyzed in the process of judgment with some expert and after that it tested to the students. The result of the test items after tested will be used, revised or deleted. The result of research analysis is attached in appendix C.3. After conducting instrument analysis, new blueprint of objective test is gained and used as research instrument. From 30 questions that have been judged and revised 15 questions are used. The blue prints of test items after instrument analyses are shown in the Table 3.3.

Table 3.3Blueprint of Objectives Test Items after Validation

No	Concept	Cognitive Domain				∑	%
		C1	C2	C3	C4		
1	Urinary system	1	2,3,4	15	-	5	33.3
2	Kidney structure	5, 8	7	-	-	3	20
3	Mechanism of Urine Formation	10	11, 12	6, 9,	13,14	7	4
Total		4	6	3	2	15	-
Percentage (%)		26	40	20	13.3	-	100

b) Questionnaire

Students' impression instruments are provided in the form of *Likert-scale* which is given to student to know about how is the impression of student toward this learning model. The indicators of the *Likert-scale* are about learning leisure in

using visuo-spatial representation are the usefulness of visuo-spatial representation, and student's preference of learning using visuo-spatial representation compare to conventional learning. The outline of *Likert-scale* is provided in Table 3.4.

Table 3.4Student's Impression Questionnaire

No	Student's Response	Indicator	Number	
			Positive statement	Negative statement
1	Students Response toward Learning Leisure in Using Visual-spatial Representation Method	Feel enjoy while they are learning in using visual-spatial representation method	1,2	3,4
		Feel comfortable while they are learning in using visuo-spatial representation method	5,6	7,8
2	Students Response toward The Usefulness of Visual-spatial Representation Method	Face a difficulties in using visuo-spatial representation method	11, 12	9,10
		Feel helpful using visuo-spatial representation by using play dough	15, 16	13, 14
3	Students Response of Learning Method Preference	Prefer learn using visual-spatial method to a conventional learning method	17, 18	19, 20
Total			10	10

2. Instrument Analysis

The instrument which is used to measure the cognitive aspect (conceptual mastery of student) is an objective test instrument, which includes to the problem of C_1 until C_4 problem. This instrument is in the form of item test, so that the analysis of instrument will be covered validity, discriminating power, level of difficulty, and reliability.

a. Validity

This validity test deals with appropriateness of information for making decision. It measure how valid the item test which applied. It provide information that helps the researcher make decision about the object that being measured (Jacob & Chase, 1992).

The validity test is conducted by comparing the student's score on a test to some external measure of the same trait that the test measures (Jacob & Chase, 1992). To determine the suitability of the instrument with the material, 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.
X = items scores
N = amount of subject

(Minium,et.al., 1993)

To determine the validity of test items in this study is done by using software ANATES version 4.0.9. The validity that has been tested then interpreted the value of correlation coefficient by using validity table as Table 3.5.

Table 3.5Validity Interpretation

Correlation Coeficient	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. Discriminating power

Discrimination power analysis is used to determine the student who is in the category in low or high achiever exactly. Thus the questions or problem which has a good discrimination power will be have a higher result if it given to the high achiever student than if it given to low achiever student (Arikunto, 2010).

The formula which is used to analyze the discriminating power is presented as follows.

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

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 the validity of test items in this study is done by using software ANATES version 4.0.9. The discriminating power that has been tested, then interpreted by using classification of discriminating power table as Table 3.6.

Table 3.6 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, 2010)*

c. Difficulty Level

The assumption that used to determine the good problem is by balancing the difficulties of problem. The ability of student in answering the difficult question is not seen from the teacher perspective.

Basic considerations in determining the proportion of categories of problems are easy, medium and difficult. The first consideration is the balance, which is about the same amount for all of three categories, the number of questions which easy, medium, and hard numbers scores. The second consideration for approximately three categories based on the proportion of the normal curve. Means, most of the problems are in the medium category, some are included in the category of easy and difficult with balanced proportions (Arikunto, 2012).The formula which used in this research to determine the level of difficulty of the problems as follows.

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

P = Difficulty level
B = Number of students who answer correctly
N= Total number of students

To determine the difficulty level of test items in this study is done by using software ANATES version 4.0.9. The difficulty level that has been tested, then interpreted by using validity table as Table 3.7.

Table 3.7Difficulty Level

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

(Arikunto, 2012)

d. Reliability

Reliability deals with the consistency of measurements, substantial reliability in all test is a goal that says test are measuring in a consistent, not haphazard, and manner (Jacob & Chase, 1992). The technique used in this research is using Alpha Cronbrach because this equation can be used in the answer that has the scale or scales dichotomic as such true (1), false (0). Split-half method is shown in the following formula.

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

Where,
r11 = Instrument reliability
n = Amount of question
$\sum \sigma_i^2$ = Amount of Varian score in each item
σ_i^2 = Varian total

To determine the reliability level of test items in this study is done by using software ANATES version 4.0.9. The reliability level that has been tested use the correlation coefficient, and then it will be interpreted by using validity table as Table 3.8.

Table 3.8Reliability 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

(Minium,et.al., 1993)

The summaryof all instrument data analysis is displayed in Table 3.9.

Table 3.9 Summary of Instrument Data Analysis Result

No	New Number	Discriminating Power (%)	Difficulty Index	Validity		Decision
				Value	Significant	
1		16.67	Difficult	-0.076	-	
2	1	33.33	Medium	0.293	-	Used with revision
3	2	66.67	Very easy	0.449	Very significant	Used
4		00.00	Very easy	0.114	-	
5	3	16.67	Very easy	0.142	-	Used with revision
6	4	16.67	Difficult	0.410	Significant	Used
7		00.00	Very easy	NAN	NAN	
8	5	33.33	Very easy	0.386	Significant	Used
9	6	50.00	Very easy	0.242	-	Used with revision
10	7	50.00	Difficult	0.504	Very significant	Used
11	8	16.67	Very easy	0.361	Significant	Used
12	9	16.67	Very difficult	0.204	-	Used with revision
13		0.00	Medium	-0.019	-	
14	10	16.67	Very easy	0.361	Significant	Used
15		0.00	Easy	0.193	-	
16	11	66.67	Medium	0.525	Very Significant	Used
17		0.00	Very difficult	0.023	-	
18		0.00	Very easy	NAN	NAN	
19		0.00	Very	NAN	NAN	
20		-33.33	Difficult	-0.200	-	
21	12	66.67	Difficult	0.609	Very significant	Used
22		0.00	Medium	0.013	-	
23		-16.67	Very difficult	-0.361	-	
24		0.00	Difficult	-0.017	-	
25		0.00	Difficult	0.185	-	
26	13	50.00	Difficult	0.489	Very significant	Used
27	14	33.33	Medium	0.377	Significant	Used
28		-16.67	Medium	-0.233	-	
29		16.67	Difficult	0.178	-	
30	15	50.00	Easy	0.523	Significant	Used

E. Data analysis

In this research the data is processed in both quantitatively and supported by qualitative data. Quantitative data processing is used for measuring cognitive aspect (pre-test and post-test), meanwhile qualitative data processing is used for knowing the students impression towards this learning method.

1. Data Analysis Toward Student Cognitive Aspect

a. 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.

1) Scoring test items

The first step to process data is scoring the test items. The test items are provided in the 15 number of questions. All of questions are provided in the form of multiple choices. And the result will be scoring, and the scores are processed using Microsoft excel.

2) Calculation of Gain Score and Normalized Gain

After get the data of the test item score, the data is process through gain score and normalized gain score. According to Hake, gain score is obtained from the differences between pre-test and post-test. 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 (1999) here is the formula to get the gain score:

$$G = S_f - S_i$$

G = Gain score
S_f = Post-test score
S_i = Pre-test score

(Hake, 1999)

The effectiveness of Visuo-spatial representation using play dough in learning Human Urinary system is seen in the result of this gain score, whether it is give a significant positive impact or not. The calculation of Normalized gain and its interpretation is used the calculation as below, according to Hake (1999). Normalized gain of each student<g> determined by the following formula.

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

Where,

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

(Hake, 1999)

The normalized gain which already obtained is categorized according to N-gain classification. The classification of n-gain provided in table 3.10.

Table 3.10 Normalized Gain score classification

Value	Category
<g> ≥ 0,7	High
0,7 ><g> ≥ 0,3	Medium
<g>< 0,3	Low

3) Normality test

Parametric statistic assume that each variable in this data of research form a normal distribution. Normality test used to know whether the sample comes from population that has normal distribution or not. In this research, Normality test is used statistic test from SPSS 18.0, ***Saphiro-Wilk*** with significance level (α) is 0,05. This data is normally distributed then it

continues with the Homogeneity and Average difference test (Sarwono, 2012).

The population categorized as normal distribution due to the significance value > 0.05, and H_0 rejected or denied with significance value < 0.05 (Sarwono, 2012). The hypothesis used in this statistical test presented as follow.

H_0: Sample comes from population that has normal distribution.
H_1: Sample comes from population that has not normal distribution.

4) Homogeneity test

Homogeneity test is used for determine a sample from population that originated from two classes that homogeny. This test is done with Test of Homogeneity of Variance in SPSS 18.0 by ***Levene's*** test, and the Significance level (α) is 0,05.

The data of this study shows a normal distributed data, so this homogeneity test is done. This data categorized as homogeny due to significance value > 0.05 but H_0 will be rejected or denied with significance value < 0.05 (Sarwono, 2012). The hypothesis used in this test presented as follow.

H_0: Each group has the same variance (Homogen).
H_1: Each group has not the same variance (Not homogen).

5) Hypothesis test

The result of normality and homogeneity test shows that this data derived from normal and homogeny sample, so that this research used t test to test the hypothesis with parametric statistic (Sarwono, 2012). This hypothesis is determined differences of average between girls and boys result. The test are using ***Levene*** test in SPSS 18.00.

This test is testing twice, in the score of the girls and boys pre-test result and also N-gain result. The testing of pre-test done in order to know

the prior knowledge of students in both classes, meanwhile the n-gain hypothesis testing done in order to know the difference of the improvement in both classes. Due to $t_{computaion} < t_{table}$, H_0 is accepted for the t-test of pre-test score, meanwhile for n-gain result H_0 is rejected due to $t_{computaion} < t_{table}$ (Sarwono, 2012). The hypothesis used in this study as follows.

a) Hypothesis to test the initial conceptual mastery (Prior Knowledge):

   H_0: There is no difference of average initial conceptual mastery result between boys class and girls class.
   H_1: There is difference of average initial conceptual mastery result between boys class and girls class.

b) Hypothesis to test the n-gain score:

   H_0: There is no difference of average of n-gain result between boys class and girls class.
   H_1: There is difference of average of n-gain result between boys class and girls class.

2. Non Test Data Analysis

a. Qualitative Data Analysis

1) Data Analysis of Students Impression Scaling

The *Likert-scale* of this research is done in order to obtain the data which really can represent the student's response of the statement given, so that the researcher be able to give four alternatives answer. This *Likert-scale* divided into two statements, positive and negative. Each of statement is given four answer choices, there are; strongly agree, slightly agree, slightly disagree, and strongly disagree. For each statement is given score as the table 3.11.

Table 3.11 Scoring Guideline of *Likert-Scale*

Statement	Strongly disagree	Slightly disagree	Slightly agree	Strongly agree
Positive Statement	1	2	4	5
Negative statement	5	4	2	1

2) Data Interpretations

Meanwhile the rubric of the *Likert-scale* is interpreted to know how the impression of the student toward this learning method. The score is turn to the percentage by using this following formula.

$$P = \frac{f}{n} \text{ x } 100\%$$

Where,
P = Percentage
f = Score from the frequency of the answer
n = score from response of the answer

The percentage is used to see how many students who gives response of strongly agree, slightly agree, strongly disagree, and slightly disagree. Finally after the data has been obtained, the data is needed to interpret by making the average of the total score of the student or of any category.

According to Suherman (2001), if the average scores of the questionnaire results of more than 3, meaning that students respond positively. Meanwhile, if the average scores of students in the focus groups is smaller than 3, meaning that students responded negatively.

F. Research Procedure

In order to make this research arranged systematically, there are three stages of procedure that had been conducted in this research, including preparation stage, implementation stage, and analysis and conclusion stage.

a. Preparation stage

In this stage, researcher focused on all of the preparation to conduct and support the research. Here are the steps of preparation stage.

a. Formulate problem to be investigated
b. Determine the focus of variable research
c. Conduct literature review of Visual-spatial representation, learning achievement, Human urinary system, and curriculum
d. Arrange the research proposal which including chapter I, chapter II, and chapter III which is presented in proposal seminar
a. Revise of research proposal after having suggestions and critics from lecturers.
e. Designteaching-learning process which will be conduct in implementation stage.
f. Report research instrument.
g. Revise instrument after having validation.
h. Prepare research license.
i. Determine research subject.

b. Implementation stage

This is the process of data collecting in the school, when the treatments to students' are implemented.

a. Determine experimental class
b. Give pre-test to the sample class to recognize the initial condition and first conception of students
c. Process pre-test result
d. Conduct research activity by implementing Visual-spatial representation method in experimental class
e. Give post-test in the sample class to recognize the improvement of conceptual mastery in the sample class

f. Give questionnaire to know the student's response towards implementation of visuo-spatial representation using wimba model in the teaching learning process

3. Analysis and Conclusion Stages

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

a. Analyze the result of the research implementation
b. Discuss and concluded for the data analysis result
c. Arrange the report of the research

G. Research Scheme

Scheme of research is a view of how is the research conducted, starting from preparation, implementation, analysis and conclusion stages. Detailed of the research scheme will be shown as Figure 3.1 in the next page.

Figure 3.1 Scheme of the Research