CHAPTER 3

RESEARCH METHOD

A. Operational Definition

To avoid confusion on understanding the content of this paper, operational definitions of variables in this study are presented as follow:

1. Interdisciplinary thinking skill is score of students in answering:

b) questions of natural science (Biology, Physics, and Chemistry) which become the *disciplinary grounding* of interdisciplinary thinking skill in excretory system;

c) questions containing perfected integrated knowledge (*advancement through integration*) in excretory system; and

d) questions which demand students' critical awareness in excretory system.

2. *Connected teaching* is teaching by connecting material of Biology that is excretory system concept with materials of Chemistry and Physics which are related with the excretory system concept. Material of Chemistry concerning principals of deposition and dissolution, Dalton Laws, and concept of buffer solution. Meanwhile, material of Physics which will be connected is about the concept of hydrostatic pressure.
3. Instructional framework which has base of dimensions of learning in this research is the organize of teaching which has grounding on five dimensions of learning by Marzano, they are 1) attitude and perceptions, 2) acquiring and integrating knowledge, 3) extending and refining knowledge, dimension 4) using knowledge meaningfully, 5) Productive habits of mind.

B. Data Source

All participants were eleventh grade students enrolled in a senior high school located on Jalan A.H. Nasution No. 27 Bandung, West Java, Indonesia. The population in this study was XI Grade Senior High School students of SMAN 24 Bandung year 2013/2014. After observation, the sample was taken two classes in

the eleventh grade, there are XI-IPA 1 and XI-IPA 2 as regular class. Those participants were assigned purposively (Sugiyono, 2002: 61) by researcher, to assure they were better than others in academic achievement. Purposive sampling technique is the sampling that is used by researcher has the spesific objective in the research. Participants were not given any compensation for their involvement in this research.

Table 3.1 *Pretest-Posttest Nonrandomized and Nonequivalent Control Group Design*

Experiment	Pretest	√	Posttest
Control	Pretest	-	Posttest

(Source: Suryabrata, 1983)

Information:

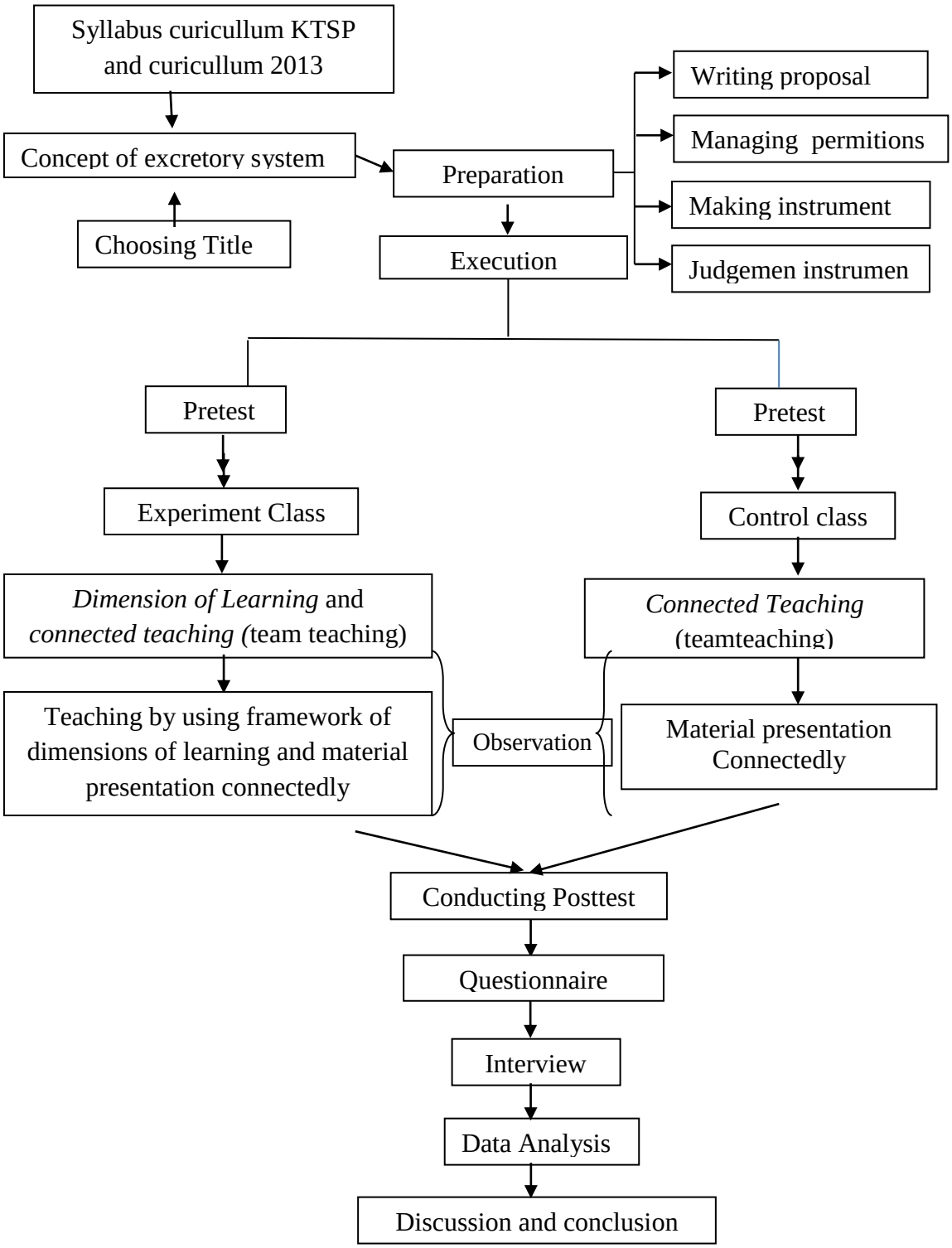
√: The application of connected teaching with instructional framework which has base of dimensions of learning (consist of: *Attitude and perception, acquire and integrate knowledge, extend and refine knowledge,* and *using knowledge meaningfully*)

-: only use *connected teaching*

C. Research Design

This research was conducted using *Quasy Experiment.* Suryabrata (1983:36) explained that *quasy experiment* has the aim to gain information which becomes prediction for information gained by true experiment in the condition of impossible to control and/or manipulate all relevant variables.

The application of connected teaching with instructional framework which has base of dimensions of learning is applied in experiment class. Meanwhile, control class is not given treatment as in experiment class. Measuring interdisciplinary thinking skill of student is done through pretest and posttest. While the research design that was incorporated in this research is *Pretest-Posttest Nonrandomized and Nonequivalent Control Group Design* (see **Figure 3.1**).



Picture 3.1 Research Design

D. Instrumentation

Below are presented the steps to develop each instrument administered in this study.

1. Judgment

The unstrument were first reviewed and judged by a group of experts. The experts are college master and doctor of either pedagogy of biology and physiological science. In total there were three experts (two of them are author's advisor). The instruments were reviewed for its construct and content validity. After the instruments were approved by the fisrt advisor, they were then administered in the pilot testing.

2. Try Out

After judgment session the instrument were administered in a pilot testing session to test its' criterion validity. The tryout was done to a sample of the kinds of individuals that will be required to respond in the final data collection. Since the participant of this research was high school students. A total of 47 high school students, the instrument were being tested to a sample of students who already learned the excretory system topic.

3. Factor Analysis

After pilot testing, the quantitative instruments were analyzed using a test item analysis. The essay item achievement test and questionnaire analysis was cinducted using the *ANATES uraian version 4.0.7 9* and IBM SPSS V.20, the analysis itself encompassed these aspects:

a. Validity

The validity index refers to a correlation coefficient that is used to *"describe the relationship between a set of scores obtained by the same group of individuals on a particular instrument and their scores on same criterion measure"* (Fraenkel *et al*., 2012:152).

b. Reliability

Reliability refers to the consistency of test scores-that is, to how consistent they are from one measurement. To measure this, researcher also used the software that was based on *Kuder-Richardson formula* 20 (KR20), which is based on the proprotion of correct and incorrect responses to each of the items on a test and the variance of the total scores (Arikunto, 2012).

c. Degree of Difficulty

Item difficulty or degree difficulty denotes the potential of a question to be answered correctly by the students. The simple step to calculate this index is by using this following formula. After the index of discrimination was obtained, researcher interpreted the value by referring to the criterion (Arikunto, 2012).

d. Index of Discrimination

Index of discrimination or Item discriminability referred to the potential items in question to show diffrerences between the groups of students. In this study the index of discrimination referred to potential of the interdisciplinary questions to differentiate students' based on their understanding of the disciplinary grounding and integration skill in the excretory system topic. The calculation within the software was based on this simple equation (Arikunto, 2012).

4. Result of Factor Analysis

The factor analysis of Multiplechoice Questions (MQ) showed that MQ have a high reliability (α= 0,78). It could also be reported that majority of test items are valid, some of the item were revised based on Judgment. While for Essay Questions (EQ), the raliability index was also high (α= 0,90). The validity analysis showed that all of MQ were having a low significance; on the contrary all of the EQ test items are valid. Some of the items ($r_{cal}>r_{table}$) were used in this study, some of them were revised based on judgment ($0<r_{cal}<r_{table}$) (see detail in the **Appendix A**).

5. Research Instruments

Table 3.2 presents instrument that are used in this study, along with their data source and the aim of its incorporation in the study.

Table 3.2 Instruments of the Study

Instruments	Data Source (Data type)	Aim
Multiplechoice Questions	Students	Measure students' disciplinary grounding and integrate skill
Essay Questions	Students	Measure students' critical awareness
Questionnaire	Students	Catch students' opinion about learning strategy
Interview	Students	Obtain additional information of the intervention
Anecdotal field note	Observation	Cover information uncovered by other instruments

a. Multiplechoice Questions

MQ is a instrument designed to asses student's disciplinary grounding and integrate skill. This instruments consist of 52 items (See Appendix B). Each of items was made based on learning objectives by Marzano (1992) (see **table 3.3**).

Table 3.3 Result of Factor Analysis for the Multiplechoice Questions

Previous No.	New No.	Index of Discrimination (%)	Reliability	Degree of Difficulty	Correlations	Validity	Information
1	-	0,00	0,78	Ver easy	NAN	Very low	Item unused
2	-	8,33		Ver easy	0,078	Very low	Item unused
3	-	8,33		Ver easy	0,252	Low	Item unused
4	1	91,67		Medium	0,770	High	Item used
5	2	50,00		Medium	0,503	Sufficient	Item used
6	-	25,00		Ver easy	0,365	Low	Item unused
7	3	58,33		Medium	0,683	High	Item used
8	-	0,00		Ver easy	NAN	Very low	Item unused
9	4	33,33		Medium	0,431	Sufficient	Item used
10	5	58,33		Medium	0,512	Sufficient	Item used
11	-	0,00		Ver easy	NAN	Very low	Item unused
12	6	41,67		Easy	0,505	Sufficient	Item used
13	-	16,67		Ver easy	0,209	Low	Item unused

Previous No.	New No.	Index of Discrimination (%)	Reliability	Degree of Difficulty	Correlations	Validity	Information
14	-	-16,67		Very difficult	-0,192	Very low	Item unused
15	7	25,00	0,78	Ver easy	0,581	Sufficient	Item revised
16	8	50,00		Easy	0,424	Sufficient	Item revised
17	-	0,00		Medium	-0,003	Very low	Item unused
18	-	0,00		Ver easy	NAN	Very low	Item unused
19	-	16,67		Ver easy	0,097	Vey low	Item unused
20	-	33,33		Ver easy	0,287	Low	Item unused
21	-	0,00		Ver easy	0,024	Very low	Item unused
22	-	8,33		Ver easy	0,115	Very low	Item unused
23	-	-25,00		Very difficult	-0,384	Vey low	Item unused
24	-	16,67		Medium	0,029	Very low	Item unused
25	9	58,33		Easy	0,694	High	Item used
26	-	-25,00		Medium	-0,149	Very low	Item unused
27	10	75,00		Medium	0,667	High	Item used
28	-	8,33		Difficult	0,064	Very low	Item unused
29	11	50,00		Easy	0,659	High	Item used
30	-	0,00		Ver easy	NAN	Vey low	Item unused
31	12	41,67		Easy	0,599	Sufficinet	Item revised
32	-	8,33		Vey easy	0,192	Vey low	Item unused
33	-	41,67		Easy	0,226	Low	Item unused
34	13	41,67		Easy	0,554	Sufficient	Item revised
35	-	0,00		Very difficult	NAN	Very low	Item unused
36	14	75,00		Easy	0,783	High	Item used
37	15	41,67		Easy	0,566	Sufficient	Item used
38	-	-8,33		Very difficult	-0,176	Very low	Item unused
39	16	75,00		Medium	0,540	Sufficient	Item used
40	17	50,00		Easy	0,706	High	Item used
41	18	41,67		Ver easy	0,484	Sufficient	Item revised
42	19	83,33		Easy	0,652	High	Item used
43	20	8,33		Ver easy	0,176	Vey low	Item revised
44	-	0,00		Ver easy	NAN	Very low	Item unused
45	-	-58,33		Medium	-0,446	Very low	Item unused
46	21	33,33		Ver easy	0,553	Cukup	Item used
47	22	25,00		Easy	0,168	Very low	Item revised
48	-	0,00		Very difficult	NAN	Very low	Item unused
49	-	-25,00		Very difficult	-0,402	Very Low	Item unused
50	-	8,33		Easy	-0,021	Very low	Item unused

Previous No.	New No.	Index of Discrimination (%)	Reliability	Degree of Difficulty	Correlations	Validity	Information
51	23	8,33		Very easy	0,176	Veyr low	Item revised
52	-	0,00		Difficult	0,005	Vey low	Item unused

b. Essay Questions

MQ is a instrument designed to asses student's critical awareness. This instruments consist of six items (See Appendix B). Each of items was made based on learning objectives by Marzano (1992) (see **table 3.4**).

Table 3.4 Result of Factor Analysis for the Essay Questions

Item	Index of discrimination (%)	Difficulty	Reliability	Correlation	Sign. Correlation	Information
1a	55,77	Medium	0,90	0,781	Very significant	Item used
1b	53,85	Medium		0,755	Very significant	Item used
1c	50,00	Medium		0,714	Very significant	Item used
2a	57,69	Medium		0,780	Very significant	Item used
2b	65,38	Medium		0,792	Very significant	Item used
2c	76,92	Medium		0,765	Very significant	Item used

c. Questionnaire

Questionnaire made was questionnaire for students to know students' assumption about learning process based on steps of connected teaching with dimensions of learning. The questionnaire admission filling was done in the fourth meeting.

d. Interview

Interview were conducted to the students after attending learning process which aims to describe students' impression about learning and difficulties in

learning. The anecdotal field note was completed by author to capture additional information uncovered by other instrument.

E. Data Processing

1. Multiplechoice Questions

MQ were scored using a scoring guide generated by author. The score of each question was one point for each correct answer and it was transfomed became value. Besides, it represent the percentage of indicators within the participant's answer of the questions, so the maximum score for this test is 100. This process implemented separately for each question of both posttest and pretest data.

In this research, questions were given in pretest and posttest. So normalized-gain value were used to know how much improvement after intervention. Based on Hake (1999:1), normalized-gain is counted by using the formulation:

$$\text{n}-\text{gain} = \frac{T2-T1}{Is-T1}$$

Explanation: T1 = Score *pretest*

T2 = Score *posttest*

Is = Score maximum pretest /posttest

Categorization of normalized gain value can be seen based on the table below:

Table 3.5 Value Category Normalized-gain

N-gain	Category
g≥0,7	High
0,3≤g<0,7	Medium
g<0,3	Low

2. Essay Question

The essay question were scored using rubric (see **Appendix A**), which made by author. The data must fisrst transformed into interval scale before furtherly

analyzes. The maximum score for this test is 100. This process implemented separately for each question of both posttest and pretest data.

3. Questionnaire

This questionnaire that consisted of ordinal sclae (5-sclae), the data were categorized based on the aspect (there were 13 aspect). Then, the data must first transformed into score in every aspect and got the average score of its aspect.

F. Data Analysis

Analysis of the data (Multiplechoice and Essay Questions) was conducted mainly using the IBM *Statistical Package Software for Social Sciences (SPSS) version 20.0.* The analysis was conducted using descriptive statistics. The assumptions test of two important properties of data distribution were also conducted to determine what type of inferential statistics test that should be conducted. The two basic assumption were: normality (using: *Kolmogorov-Smirniov Test)* and homogenity using (*Levenes Statistics*). After the assumptions tests, researcher used statistics test to examine the proposed hypotheses as featured in **Table 3.6.** Detailed result of each test were included in the **Appendix C**.

Independent sample test was incorporated in this study if the data distribution was normal. On the contrary, if the data distribution un-normal, then the data were transformed for got the normal data, but if un-normal consistent, so the data were analyzed using non-parametric test (*U-Mann Whitney Test)*.

Table 3.6 Statistical Test to Examine Hypotheses

	Hypotheses	**Statistical Test**
H_{1-1}	*There is a significant difference of students's disciplinary grounding in experiment and control class*	Independent sample t-test or U-Mann Whitney test
H_{1-2}	*There is a significant difference of students's advancement through integration in experiment and control class*	Independent sample t-test or U-Mann Whitney test

Hypotheses	Statistical Test	Hypotheses
H_{1-3}	*There is a significant difference of students's critical awareness in experiment and control class.*	Independent sample t-test or U-Mann Whitney test
H_{1-4}	*There is a significant correlation among interdisciplinary thinking skill component.*	Pearson Product Moment or Spearmann Correlation

To specifically adress the fisrt until three research question, normalized gain between pretest and posttest were also calculated (See **Appendix D** for the detailed result). The acquired scores of the gain could the be used to show the effectiveness of the given intervention. The normalized-gain was then categorized based on standards appointed by Hake (1999:1). After completing the data analysis, crosscheck to the literature review was also conducted to explain important findings.

G. Procedure of the Research

Research procedure covers all the things done starting from the beginning step of problem determination until the final step of making conclusion. In the preparation step, design teaching strategy is made for experiment and control class. After making teaching scenario, the next step is making instruments and doing validation. In the step of conducting research, *pretest* is done. Then learning activities are done in experiment and control class. In experiment class and control class material of excretory system is presented in *connected* way. However, in experiment class instructional framework based on learning dimensions developed by Marzano *et al.* (1992) consist of four dimensions: dimension I *attitude and perception*, dimension II *Acquiring and Integrating Knowledge*, dimension III *Extending and Refining Knowledge* and dimension IV *Use Knowledge Meaningfully*. Meanwhile, control class uses conventional method. To distinguish teaching process done in experiment and control class can be seen in the **Table 3.7.**

Table 3.7 Comparison of Teaching Process in Experiment and Control Class

Experiment Class	Control Class
I *Attitude and Perception*	**Opening**:
• Teachers greet students and make the conditions of class become comfortable for students • Teachers attract students' attention by displaying video about dialysis and kidney • Teachers tell phenomena of kidney stone and obligation of dialysis every week for the whole lifetime to motivate students by explaining the importance of keeping health • Teachers give some productive questions related to the video they have seen • Teachers explain the aim/goal of learning and also the benefits of learning material of excretion system • Teachers give reference	• Teachers attract students' attention by displaying video about dialysis and kidney stone • Teachers motivate students to explain the importance of keeping health, especially excretion system • Teachers ask questions to students related to the video that have been displayed • Teachers explain the aim/goal of teaching and give reference • Teachers connect material of excretion system with material that have been discussed that is respiratory system
II Acquiring and Intergrating Knowledge	**Main Activity**:
• Teachers show facts visually about excretion activities • Students construct definition of excretion system • Students give declarative questions about excretion system so that they remind specific information about material respiratory system that related to excretion • Students give descriptive questions about organs excretion and students are asked to identify and describe torso excretion organs • Teachers give explanation about anatomy, morphology, and physiological organs excretion in human by connecting it with the subjects of Chemistry and Physics to facilitate students in integrating new knowledge with *prior-knowledge* they have got • Students construct their own knowledge and internalize them by distracting their understanding in the form of circulation chart, diagram, and others forms especially about	• Teachers explain structure of anatomy, morphology, and physiology excretion organ in human • Materials are presented connected with others relevant subjects, such as concept of Chemistry about buffer solution to explain mechanisms of urine forming, stone kidney forming. Besides, submaterial of excretion system is connected with the subject Physics about pressure principles in the concept of *countercurrent multiplier*. • Teachers display video to strengthen concept of students's understanding about the physiological process in excretion system • In the next meeting, practical activity of urine test is conducted

excretion process in human • During teaching process, teachers give *oral feed back* and motivation		• Students present the result of practical activities and collect report of practical activities During teaching process, teachers give *oral feed back* when students ask questions about material that is not understood
• Some students are asked to explain process of excretion in liver, skin, kidney, and lung in front of the class • Teachers facilitate students to assimilate and accomodate knowledge • Teachers show pictures of excretion organs such as flatworm, ground worm, insects, and kidney in vertebrae to explained evolutionary variations of excretion organs • Students are asked to make difference about excretion system in animals trough pictures in slides • Teachers explain abnormality and disease in excretion system and ask students to analyze mistakes and disturbance occurred in organs which are possibly occurred those disease from the perspective of disciplines (Chemistry and Physics)		Closing: • Teachers review materials that have been discussed • Teachers give postest questions to find the result of students' learning
IV *Using Knowledge Meaningfully* • Students are instructed to bring urine samples for practical work urine composition test • Orally students are asked to determine what tools used in practical work urine test • Students grouped in five or six people do experiment group members' urine composition test • Students interpret and analyze the result of urine test and discusse the result of practical work with their group • Students fill and answer questions in paperwork based on practical work that have been conducted		

In the fourth meeting in the end of teaching activity, *posttest* is done and questionnaire is collected to find students' opinion about teaching process that have been done. To complete data, interview is done toward students about

obstacles faced by them and also about students' impression during teaching process. Summary of all procedures of this research is presented in the **picture 3.2**.

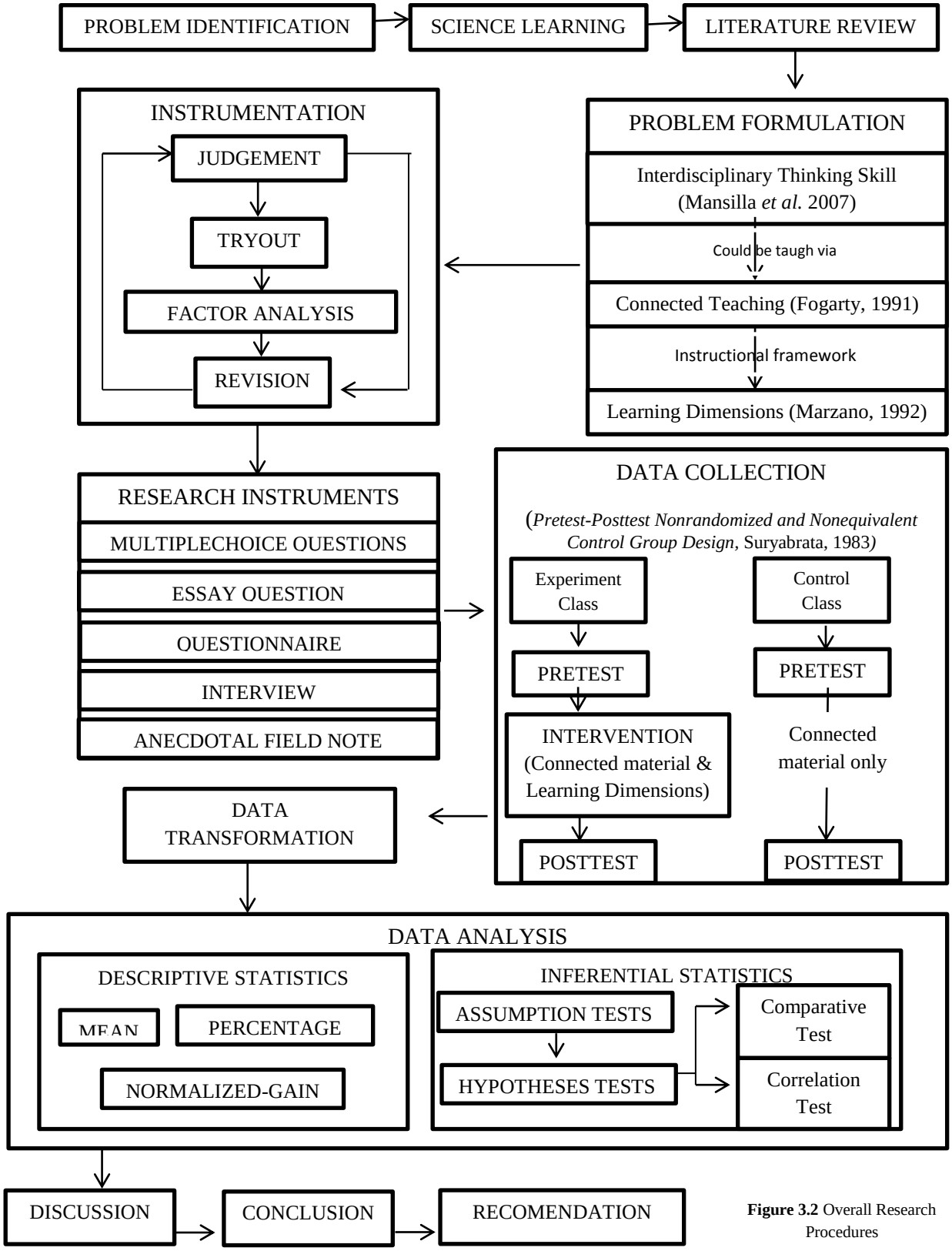


Figure 3.2 Overall Research Procedures