CHAPTER III
RESEARCH METHODOLOGY

A. Research Method and Research Design

1. Research Method

The research method that was used in this research is Quasi Experiments. Cresswell (2012) stated that in education, many experimental situations occured in which researchers need to use intact groups. This might happen because of the availability of the participants or because the setting prohibits forming artificial groups.

Quasi-experiments include assignment, but not random assignment of participants to groups. This is because the experimenter cannot artificially create groups for the experiment. Randomly assigning students to the two groups would disrupt classroom learning. Because educators often use intact groups in experiments, quasi-experimental designs are frequently used (Creswell, 2012). This method is appropriate with the purpose of the research which was investigating the effect of brainstorming on student's creative thinking skills and concept in learning nutrition. The experimental class was taught by using brainstorming, while control class was taught by using discussion method.

2. Research Design

The design that was used in this research is pre-test post-test design. To equate the characteristics of the groups, experimental researchers may use a pretest. A pretest provides a measure on some attribute or characteristic that you assess for participants in an experiment before they receive a treatment. After the treatment, you take another reading on the attribute or characteristic. A posttest is a measure on some attribute or characteristic that is assessed for participants in an experiment after a treatment.

Table 3.1 Pre-test and Post-test Design

Select Control Group	Pre-test	No Treatment	Post-test
Select Experimental Group	Pre-test	Experimental Treatment	Post-test

(Creswell, 2012)

B. Population and Sample

The location of this research was an Islamic International Junior High School in Bandung. This school is located in urban area of Bandung. This school use English as their main language and Bahasa Indonesia (in Indonesian language, civics education, and social studies subject) and also Arabic (in Arabic language subject). This school use the mix of Cambridge IGCSE and *Kurikulum 2013* as its curriculum.

The population of this research was 7th grade students. The samples are 7th grade students from two classes, where one of them was assigned as experimental and the other as control group.

The sampling technique that was used in this research is Purposive Sampling. Purposive sampling was based on previous knowledge of a population and the specific purpose of the research, investigator use personal judgment to select a sample. 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. (Fraenkel, Wallen & Hyun, 2007).

C. Assumption

The assumptions as the foundation of this study is as follow:

1. Students' creative thinking skills significantly increased for the students who learn using brainstroming strategies (Taleb, Hamza & Wefky, 2013).

2. Students' understanding of those who are trained through brainstorming is higher than the achievement of those who are trained via explanatory method (Rizi et al., 2013).
3. Students' academic achievement as well as creative thinking skills of those who are trained by brainstorming is higher than those who are trained by computer education in learning engineering (Sdouh, 2013).

D. Hypothesis

Hypothesis that was tested in this study are as follow:

1) The effect of brainstorming on students' creative thinking skills in learning nutrition

   H_0: There is no significant difference of students' creative thinking skills in learning nutrition between groups that was taught using brainstorming and conventional discussion method.

   H_1: There is significant difference of students' creative thinking skills in learning nutrition between groups that was taught using brainstorming and conventional discussion method.

2) The effect of brainstorming on students' concept mastery in learning nutrition

   H_0: There is no significant difference of students' concept mastery in learning nutrition between groups that was taught using brainstorming and conventional discussion method.

   H_1: There is significant difference of students' concept mastery in learning nutrition between groups that was taught using brainstorming and conventional discussion method.

E. Operational Definition

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

a. Learning activities using Brainstorming technique is done by constructivist learning. Learning process is conducted by using a technique in which a group engages in critical thinking to generate wide-ranging ideas toward solving a problem. The implementation of brainstorming this research was observed by observation sheet.

b. Students' creative thinking skills in this research refers to the one that has been developed by Ellis Paul Torrance. Creative thinking skills by Torrance consists of fluency, flexibility, originality, and elaboration. In this research, students' creative thinking skills was measured by verbal TTCT (Torrance Test of Creative Thinking) that has been modified to be in line with the topic of nutrients. Consisted of six questions – one about asking question, one about guessing causes, one about guessing consequences, one about product improvement, one about unusual uses and one about 'just suppose'. Each questions assessed fluency, flexibility and originality of students' creative thinking skills.

c. Students' concept mastery in this research is the competence of students that cover several levels of cognitive skill such as remembering (C1), understanding (C2), applying (C3), Analyzing (C4), and Evaluating (C5). Students' concept mastery in this research was measured by using objective test which consisted of 15 multiple choice questions; 4 questions in C1 level, 3 questions in C2 level, 2 questions in C3 level, and each 3 questions in C4 and C5 level.

F. Research Instrument

In this research, instrument is necessary to be used for gaining data. There are two types of instrument that are used in this research:

Table 3.2 Instruments Needed for Research

Data Needed	Instrument
Implementation of Brainstorming	Observation Sheet
Test for measuring students' concept mastery	Objective Test
Test for measuring students' creative thinking skills	Verbal TTCT

Those instruments are described below:

1. Observation Sheet

Observation sheet in this research contains the stages of activities which have to be done by the researcher in implementing brainstorming which has been adapted according to activities related with nutrition. The function of the observation sheet this research was to make sure that the researcher follows the appropriate steps while implimenting the brainstorming during the research and also acts as a guideline for the researcher. Observation sheet was in the form of checklist with 'yes' and 'no' column. The observation sheet was filled by the observer who was the science teacher of the school.

2. Objective Test

Objective test is performance test that provide two or more possible responses and require the examinee to make a selection. The objective format that was used in this research is multiple choice. The objective test consist of 15 questions and the cognitive skill level that was tested in this objective test are C1 (remembering), C2 (understanding), C3 (applying), C4 (analyzing) and C5 (evaluating).

Table 3.3 Blue Print of Nutrition Objective Test

No.	Subtopic	C1	C2	C3	C4	C5	Total
1	Nutrition	1, 2				14, 15	4
2	Chemical test of nutrients		3	4, 6	5		4
3	Uses of microorganism in industry		11		12	13	3
4	Food Additive	8, 10	7		9		4
Total Test Item		4	3	2	3	3	15
Percentage (%)		26.7%	20%	13.3%	20%	20%	100%

The uses of objective test are:

a. Pretest

Pretest was conducted before the treatment was given to students. The purpose is to know students' prior knowledge

b. Posttest

Posttest was conducted after the treatment given to students. The purpose is to find out whether or not there is significant difference of students' concept mastery between control and experimental group.

The instrument questions were analyzed with the following requirements.

a. Validity

According to Fraenkel, Wallen & Hyun (2011), there are several things that must be considered before choosing and preparing an instrument and that is validity. Validity was defined as the extent to which an instrument measured what it claimed to measure. Validity concern with interpretations or inferences that are drawn based on the data obtained through the use of an instrument. The software ANATES was used to determine the validity of the objective test research instrument in this study.

The validity of each test item can be measured by using formula:

$$r_{xy} = \frac{N\,\Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{\{N\Sigma X^2 - (\Sigma X)^2\}\{N\Sigma Y^2 - (\Sigma Y)^2\}}}$$

(Kaplan & Saccuzzo, 2013)

Where:

ΣX = Total score of all students in that item

ΣY = Total score all students in the test

N = Number of students

X = Score of each students in that item

Y = Total score of each students

r_{xy} = Item validity

Arikunto (2013) describes that the correlation coefficient between x and y interpretation is divided into some distinct categories as shown in the following table:

Table 3.4 Interpretation of validity score

r_{xy} value	**Interpretation**
$0.80 < r \leq 1.00$	Very high
$0.60 < r \leq 0.80$	High
$0.40 < r \leq 0.60$	Enough
$0.20 < r \leq 0.40$	Low
$0.00 < r \leq 0.20$	Very low

(Arikunto, 2013)

b. Reliability

Reliability of instrument is the degree of consistency with which it measures whatever it is measuring. Reliability is concerned with the effect of error on the consistency of scores (Ary, Jacobs and Sorensen, 2010).

The formula used to measure reliability of test item in this research is using Kuder-Richardson formula as follow:

$$KR_{21} = \left[\frac{K}{K-1}\right]\left[1 - \frac{M\,(K-M)}{K\,(SD^2)}\right]$$

(Fraenkel, Wallen and Hyun, 2011)

Where:

K = number of items on the test

M = mean of the set of test scores

SD = standard deviation of the set of test scores

Table 3.5 Reliability Interpretation

Reliability Coefficient	Interpretation
$0.80 < r \leq 1.00$	Very high
$0.60 < r \leq 0.80$	High
$0.40 < r \leq 0.60$	Enough
$0.20 < r \leq 0.40$	Low
$0.00 < r \leq 0.20$	Very low

(Arikunto, 2013)

c. Difficulty Level

Difficulty level defined as the proportion of the examinees that marked the item correctly. Item difficulty is the percentage of the students that correctly answered the item. Since the test item have a big role in determining the result of the research then the test item difficulty should be arranged in balance, so that the students will not feel desperate because it is too hard or feel not challenged because it is too easy. The formula to determine difficulty level is as follow:

$$DL = \frac{R_U + R_1}{N_U + N_1}$$

(Boopathiraj & Chellamani, 2013)

Where:

R_U= the number of student in the upper group who answer correctly

R_1 = the number of student in the lower group who answer correctly

N_U = number of student in the upper group

N_1 = number of student in the lower group

Table 3.6 Interpretation of Difficulty Level

Difficulty Value	Criteria
0.00 – 0.30	Hard
0.31 – 0.70	Fair
0.71 – 1.00	Easy

(Arikunto, 2013)

d. Discriminating Power

Discriminating power of a test refers to the degree to which success or failure an item indicates possession of the ability being measured. It determines the extent to which the given item discriminates among the examinees in the function or ability measured by the item. This value ranges between 0.0 and 1.00. A highly discriminating item indicates that the students who had high test mark got the item correct whereas the student who had low mark got the item incorrect (Boopathiraj & Chellamani, 2013).

The formula used to analyze discriminating power is as follows:

$$D = \frac{R_U - R_1}{\frac{1}{2}(N_U + N_1)}$$

(Boophatiraj &Chellamani, 2013)

Where:

R_U = the number of student in the upper group who answered correctly

R_1 = the number of student in the lower group who answered correctly

N_U = number of student in the upper group

N_1 = number of student in the lower group

The score of disciminating power can be classified as follow:

Table 3.7 The Classification of Discriminating Power

D	Quality	Recommendation
0.00 – 0.20	Poor	Discard / review in depth
0.21 – 0.40	Fair	Need to check / review
0.41 – 0.70	Good	Possibilities for improvement
0.71 – 1.00	Very Good	Retain

(Arikunto, 2013)

e. Distractor

Distractors are the stuff of multiple choice items, where incorrect alternatives are offered, and students have to select the correct alternatives. This simple frequency count of the number of time a particular alternative is selected will provide information on the effectiveness of the distractor; if it is selected many times then it is working effectively, if it is seldom or never selected then it is not working effectively and it should be replaced (Cohen, Manion, & Morrison, 2007).

4. TTCT (Torrance Test of Creative Thinking)

Students' creative thinking skills, specifically in fluency, flexibility and originality aspects was measured by verbal TTCT that is already adapted with the topic of nutrition. There are six questions that represent their creative thinking skills in asking, guessing causes, guessing consequences, product improvement, unusual uses and just suppose. The score range is from 0 to 3.

Table 3.8 Blue print of Verbal TTCT

No.	Subtest	Aspect to be Measured	Quantity of Question
1	Asking	• Flexibility • Fluency • Originality	1
2	Guessing causes		1
3	Guessing consequences		1
4	Product Improvement		1
5	Unusual Uses		1
6	Just Suppose		1
Total Test Item			6
Percentage			100%

The uses of verbal TTCT are:

a. Pretest

Pretest was conducted before the treatment was given to students. The purpose is to know students' prior creative thinking skills.

b. Posttest

Posttest was conducted after the treatment given to students. The purpose is to find out whether or not there is significant difference of students' creative thinking skills between control and experimental group.

G. Instrument Analysis Result

1. Recapitulation of Students' Concept Mastery Instrument

The instrument draft for measuring students' concept mastery was made into 15 questions. After the questions were made, then it was tried toward 8th grade Junior High School Students from the same school. The reason is because they have already learnt about the material that was covered in the research. The result of the test then tested by validity, reliability, discriminating power and difficulty level that was calculated by ANATES. The recapitulation of the test item analysis is shown as follows:

Test Reliability: 0.76 (High degree of reliability)

Table 3.9 Recapitulation of Test Item for Students' Conceptual Mastery

No.	DP	Category	DL	Category	Validity	Category	Status
1	18.18	Poor	72.50	Easy	0.24	Low	Revise
2	63.64	Good	82.50	Easy	0.51	Fair	Retain
3	0.00	Poor	60.00	Moderate	0.08	VL	Revise
4	81.82	VG	65.00	Moderate	0.62	High	Retain
5	36.36	Fair	50.00	Moderate	0.40	Low	Revise
6	18.18	Poor	20.00	Hard	0.28	Low	Retain
7	63.64	Good	35.00	Moderate	0.52	Fair	Retain
8	54.55	Good	45.00	Moderate	0.39	Low	Retain
9	63.64	Good	62.50	Moderate	0.59	Fair	Retain
10	72.73	VG	57.50	Moderate	0.59	Fair	Retain
11	54.55	Good	32.20	Moderate	0.44	Fair	Retain
12	81.82	VG	45.00	Moderate	0.58	Fair	Retain
13	45.45	Good	20.00	Hard	0.37	Low	Revise
14	72.73	VG	45.00	Moderate	0.69	High	Retain
15	90.91	VG	47.50	Moderate	0.81	VH	Retain

2. TTCT Instrument Requirement

TTCT instrument which is aimed to measure students' creative thinking skills was validated by supervisors and experts. The validation is conducted to see whether or not the questions are appropriate with the nutrition topic as well as its appropriateness with TTCT format. This instrument consist of six question that measured students' creative thinking skills in asking, guessing causes, guessing consequences, improving product, finding unusual uses of something and just suppose.

3. Instrument Non-Test Requirement

There was one instrument of non-test requirements in this research, which was observation sheet. The observation sheet is filled by the observer during the implementation of brainstorming. The observer place a tick mark on yes column if the activity was implemented and on no column if the activity was not implemented.

H. Data Processing Technique

There two kinds of data in this research, which is quantitative and qualitative data. Quantitative data was obtained from pretest and posttest of students' concept mastery test and also pretest and posttest of students' creative thinking skills test, which is TTCT. While qualitative data was obtained from observation sheet. Explanation of data processing techniques are as follows:

1. Quantitative Data Processing

a. Score of Item Test

The score of test item for measuring the improvement of students' concept mastery and creative thinking skills are obtained from the set of test items that consist of 15 questions for concept mastery test and 6 questions for TTCT (creative thinking skills test). Each question in concept mastery test is given one score if the answer is correct and

zero if incorrect, while for TTCT, the score range is from 0 to 3 for each aspect (fluency, flexibility, and originality)

b. Calculation of Gain Score and Normalized Gain

After the data of test item score is obtained, thus the data was proceed by calculating gain and normalized gain score. Gain is calculated to determine the differences between pretest and posttest score, so that the improvement can be seen clearly. It could be assumed as the effect of the treatment. After the actual gain is obtained, then normalized gain (N-Gain) can be obtained. Normalized gain calculation is intended to determine the categories of students' achievement improvement.

According to Hake (1998), gain score can be calculated by the following formula:

$$G = S_f - S_i$$

(Hake, 1998)

Where:

G = Gain score

S_f = Posttest sore

S_i = Pretest score

The effectiveness of brainstorming implementation in increasing students' creative thinking skills and concept mastery can be seen from the result of the normalized gain that was achieved by the students during the learning process. Normalized gain can show the meaningful improvement rather than the actual gain because the improvement of higher and lower achiever students can be shown clearly. The formula of N-Gain is as follows:

$$< g > = \frac{\% < G >}{\% < G > max} = \frac{(\% < Sf > - \% < Si >)}{(100 - \% < Si >)}$$

(Hake, 1998)

Where:

<g> = average normalized gain

<G> = actual average gain

<Sf> = final (posttest) class average

<Si> = initial (pretest) class average

Table 3.10 Interpretation of Normalized Gain Score

Normalized Gain Score <g>	Interpretation
<g> ≥ 0.7	High
0.7 > <g> ≥ 0.3	Medium
<g> < 0.3	Low

(Hake, 1998)

c. Normality Test

The use of parametric analysis has a deal with assumption that each analyzed variable in this research is normally distributed. If the data is not normally distributed, the homogeneity variance test cannot be done and the parametric technique also cannot be used. Normality test aims to know the sample which comes from population has normal distribution or not. In this research, normality statistic test was done by using SPSS 17 ***Kolmogorov-Smirnov*** with significance level of (α) 0.05. The statistic criteria as if significance value more than 0.05, hence data is normally distributed if the significance value is more than 0.05 and data not normally distributed if the significance value is less than 0.05.

d. Homogeneity Test

Homogeneity test is used to determine a sample from population that is originated from two classes that homogenous. The homogeneity test in this research is also uses statistic test from SPSS 17, with significance level of (α) 0.05. When the significance value ≥ 0.05, the data are considered as homogenous (Sudjana, 2005). If two samples

which were taken have homogenous variance so the difference of both means can be done by using T test. But, if the sample which were taken have non-homogenous variance, the difference of two means can be done by using t' test.

e. Independent T-Test and Mann-Whitney Test

Independent T-Test was used in analyzing the TTCT (Torrance Test of Creative Thinking) result. This test was done to find out whether or not the two groups; experimental and control group have the same mean after the implementation of brainstorming in the term of their creative thinking skills. This test was presented by the result of pretest and posttest score in experimental and control group. T-test required data which is normally distributed and homogenous. In SPSS 17, the test that was used was *Independent T-test.* According to Sudjana (2005), if the level of significance (sig) > 0.05 H_0 is retained.

Mann-Whitney test is non-parametric analysis test which is used when the data show that the distribution from one or all data is not normally distributed, if the level of significance (sig) < 0.05 H_1 is retained. This test was used to analyze the result of objective test (test to measure students' concept mastery.

Hypothesis that is tested in this research are as follow:

1) The effect of brainstorming on students' creative thinking skills in learning nutrition

   H_0: There is no significant difference of students' creative thinking skills in learning nutrition between groups that was taught using brainstorming and conventional discussion method.

   H_1: There is significant difference of students' creative thinking skills in learning nutrition between groups that was taught using brainstorming and conventional discussion method.

2) The effect of brainstorming on students' concept mastery in learning nutrition

H_0: There is no significant difference of students' concept mastery in learning nutrition between groups that was taught using brainstorming and conventional discussion method.

H_1: There is significant difference of students' concept mastery in learning nutrition between groups that was taught using brainstorming and conventional discussion method.

2. Qualitative Data Processing

The qualitative data was obtained from observation sheet. The analysis of observation sheet is conducted by converting the raw score into percentage form. The technique of converting the score into percentage was by using the following formula:

$$P = \frac{R}{MS} \times 100\%$$

(Arikunto, 2010)

Where:

P = percentage

R = raw score

MS = maximum score

The percentage observation sheet on brainstorming implementation can be interpreted and categorized into certain criteria according to Arikunto (2013) as shown in the Table 3.11.

Table 3.11 Interpretation of Brainstorming Implementation Percentage

Percentage (%)	Criteria
80-100	Very Good
66-79	Good
56-65	Enough
40-55	Lack
<40	Very Lack / Failed

(Arikunto, 2013)

I. Research Procedure

In order to make this research systematically arranged, there are three stages of research procedure that was conducted including the preparation, implementation, and completion stage.

a. Preparation Stage

1) Formulating problem that is going to be investigated
2) Determining the objective of the research
3) Analysis of *Kurikulum 2013* and Cambridge IGCSE Curriculum
4) Analysis of brainstorm technique
5) Analysis of students' creative thinking skills
6) Analysis of students' concept mastery
7) Analysis of nutrition topic
8) Constructing research instrument
9) Validating the research instrument by expert judgement.
10) Limited test for objective test
11) Analyzing the data by ANATES to check the validity, reliability, diffuculty level, discriminting power, and distractor of the test item in objective test
12) Revising the research instrument.

b. Implementation Stage

1) Pretest
2) Giving treatment; brainstorming to experimental, discussion method to control group
3) Posttest
4) SPSS test for testing hypothesis

c. Completion Stage

1) Making a result and discussion
2) Making a conclusion based on data analysis
3) Reporting the result.

In order to have a clear overview on the research procedures, Figure 3.1 below shows the simplified research flowchart of this research.

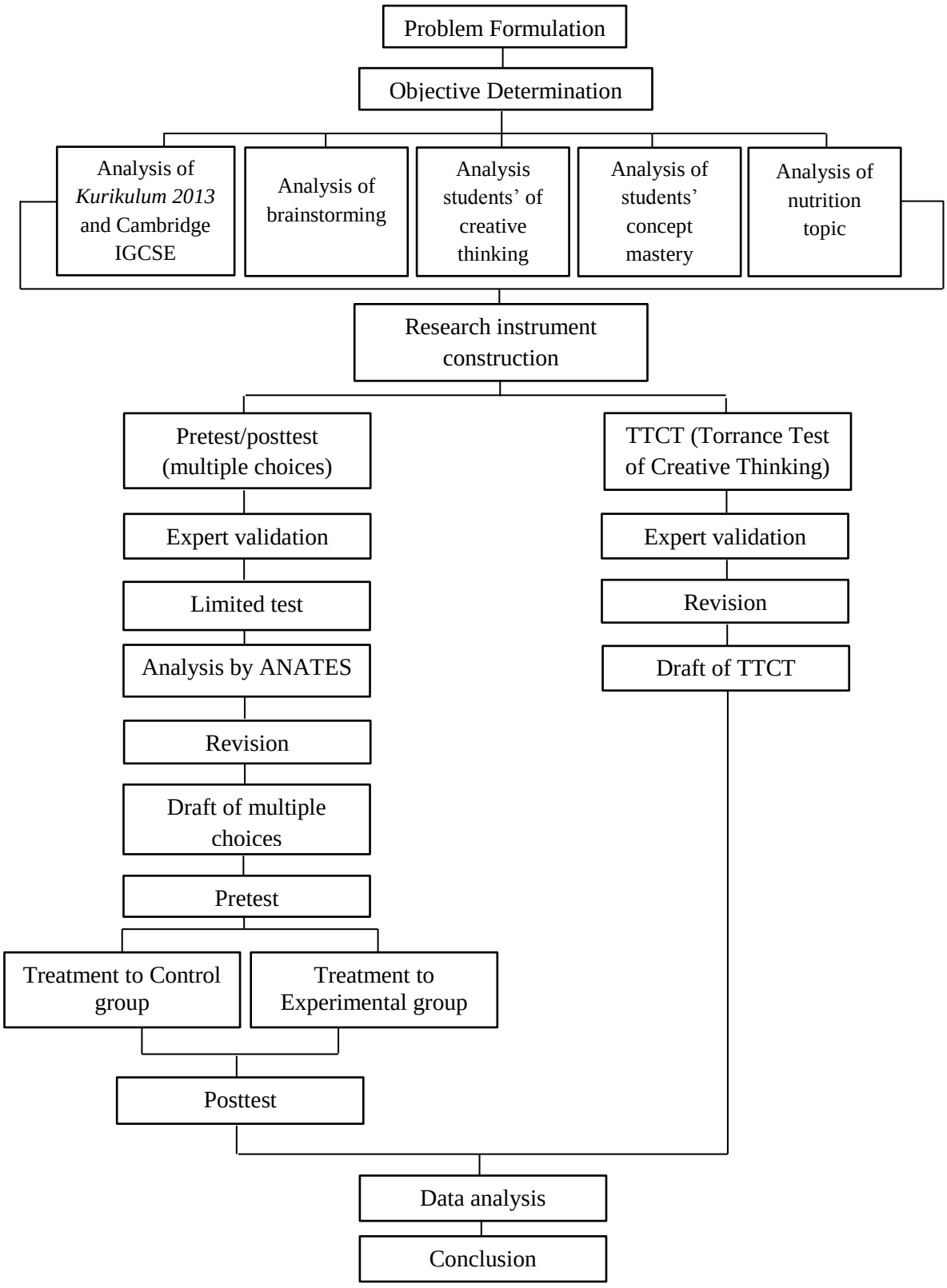

Figure 3.1 Research Procedure