CHAPTER III
RESEARCH METHODOLOGY

3.1 Research Method and Research Design

3.1.1 Research Method

In education, many experimental situations occur in which the researcher needs to use the intact group, this might happen because of the availability of the participants or because the setting prohibits forming artificial groups. The research method that is used is an Experimental Method or weak experimental, based on Fraenkel, Wallen, & Hyun (2011) which in addition to the independent variable, there are a number of other plausible explanations for any outcomes that occur.

3.1.2 Research Design

The research design used weak experimental the one group pretest posttes design defined as a single group or there in no control class, that is measured or observed not only after being exposed to a treatment of some sort, but also before (Fraenkel, Wallen, & Hyun 2012). The implemented of the research design for experimental class were students given pretest before they used media learning as treatment and learned about the topic.

The experimental group or class given treatment by "Educational Quartet Card Game based Learning" during students learned about food additive substances topic and also the effect of them. After the posttest distributed to the experimental class, the form pretest and posttest was used is a paper test of the multiple choices to evaluate the students' conceptual understanding of the topic that students' which have been learned during given the treatment. The pretest posttest was used in this study, as it is presented in Table 3.1

Table 3.1
The One-Group Pretest-Posttest Design

O	*X*	*O*
Pretest	Treatment	Posttest

(Fraenkel, Wallen, & Hyun, 2012)

3.2 Population and Sample

The location of this research was Private International School located in Bogor, West Java. The curriculum that was used in this school is National Curriculum 2013 combined with Cambridge International Curriculum and uses English as the main language in the learning teaching process. The population in this research was at 7th grade students. There were used 2 classes of 7th grade students in this school that selected as the participants, which are 7E and 7T as experiment class.

Convenience sampling was used as a sampling technique that was applied in this research. Based on Fraenkel, Wallen, & Hyun (2012) stated that a convenience sample is a group of individuals who (conveniently) are available for study.

3.3 Operational Definition

In order to conduct the study in accordance with the expected aims and avoid misunderstanding, operational definition need to be elaborated as a follows:

1. Educational Card Game

   In this study, the educational quartet card is games can student play with teacher's guidance. The topic learned by the student using an educational card game is food additives substance. The students will use and play the educational card game in learning activity as a learning tool or media. The educational card games is a group of two-dimensional card which contains a picture and brief information of food additive substances that will be played by the students in order to learn food additive substances topic.

2. Students' Conceptual Understanding

   The conceptual understanding of this study focuses on the topic of food additives substances, which is divided into three sub-topics. There is different kinds of food additives substances, natural and synthetic food additives substances, and additives substances in food and drink (Curriculum, 2013). This part has an objective to measure how effective educational card game in assisting the students' thinking ability to reach the cognitive level domain. Mastery in this research is the competence that covers the level cognitive by

Anderson and Krathwohl (2001) in the revised Blooms's Taxonomy, such as remembering (C1), Understanding (C2), applying (C3), analyzing (C4). This competence can be measured using multiple choice questions (Pretest and Posttest).

3. Students' Motivation

   Motivation in learning in this study is referring to ARCS Model that has been developed by Keller 1987. The components of motivation in learning are measured by Attention, Relevance, Confidence, and Satisfaction. Data obtained through questionnaire that is adapted from ARCS Model given for the students at the end of the treatments.

3.4 Assumption

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

1. Game-based learning used educational quartet card game is enjoyable. As a teaching media, educational card game had an excellent capacity to improve the students' motivation in learning food additives substances topic in the class. By playing the educational card in the learning activity through the games, the students would be able to memorize complicated names or characteristics.
2. Education quartet card games are found to be more effective in enhancing the understanding of science concepts than the traditional method teaching. It is also learning activity which is very useful as a supplementary material for reinforce gained understanding. In addition, the students can assist in the formation of higher conceptual abstraction.
3. An educational game uses an educational strategy to help learners gain understanding by participating them in a competitive exercise with current rules.
4. The useful instrument or teaching media that can make the students get motivated while finding himself use educational game called teaching by using the media, these media could also enjoy the condition in the process at the same moment.

5. The educational card game can be suitable teaching strategies; the media can influence intrinsic students' motivation in learning.

3.5 Hypothesis

The hypothesis that is tested in this study is as follow:

H_0: There is no difference of students' conceptual understanding and students' motivation in learning food additives substances using educational quartet card game based learning.

H_1: There is a difference of students' conceptual understanding and students' motivation in learning food additives substances using educational quartet card game based learning.

3.6 Research Instrument

In this study, it is essential to use the tool to obtain information. There are three types of tools that are used in this study, the objective test, the heading and the observation sheet. The following tools are defined:

3.6.1 Rubric Judgment

In this step, the rubric form (see appendix B) were submit to the expert judgment and the research objective test, questionnaire and validation content. The expert that researcher proposed come from chemistry, biology and junior high school teacher. On the judgment form, the expert corrected the item test whether it has to reject, revise or retain. After reviewing and correcting from the expert judgment, the instruments are prepared to submit to the next step, which is validity. Validity step test that item test applied to the 8^{th} grade of junior high school, who already learned about the food additive substances when they in 7^{th} grade. The item test was evaluated after answering the objectives test question and the validity test was tested.

3.6.2 Observation Sheet

The observation sheet in the research contains the steps of teaching activities in the class, which has been done by the researcher in implemented the Educational Quartet Card Games Based Learning on experiment class. The function of observation sheet used in research to make sure the researcher follows

the appropriate steps while implementing the Educational Quartet Card Game and also act as a guideline for the researcher. The observation sheet would be filled by the observer. The more detail of observation sheet will be shown in Table 3.2

Table 3.2
The Observation Sheet Experiment Class

Step	Learning Experience	Implementation	
		Yes	No
Opening	Teacher great the students		
	Teacher check attendance of students		
	Teacher ask the student to pray before start the learning		
	Teacher deliver about what will be learn today		
Main Activity	Student are divided to several groups (group consisted 4-5 students)		
	Teacher explain about the rules of Quartet Card Games to students		
	Students are playing the game		
	Teacher guiding the game step by step, by asking to the students the way to do the game and clarify the wrong way that students do		
	Teacher inviting the students to give conclusion of the lesson		
Closing	Teacher giving an post-test for the students		
	Teacher given an questionnaire for the students		
	Teacher closing the class by pray together and say goodbye		

3.6.3 Objective Test

Objective test is used to assess students' conceptual understanding in learn food additives substance. In this study, the objectives test formed of multiple choices and consist 28 questions. The question distributed before and after the participant learned about food additives substances. The pretest distributed before the participant learn about food additive substance and posttest distributed after all participant has been learned food additives substances by researcher to see the effect of educational quartet card game on students' conceptual understanding. To measure conceptual understanding was used Revised Bloom's Taxonomy, there are remembering (C1), understanding (C2), applying (C3) and analyzing (C4) and sub-topic of food additives substance as an indicator.

Table 3.3
Blue Print of Objectives Test Item

No	Sub Topic	Cognitive Level Domain and Number of Item test				%
		C1	**C2**	**C3**	**C4**	
1	Different kinds of food additives substances	1	12, 14	2	21,23, 26	25
2	Natural and synthetic food additives substances	3, 4, 7	13	15, 17, 19, 20	24, 28	36
3	Additives substances in food and drinks	5, 6	8, 9, 11, 10	16	18, 22, 25, 27	39
	TOTAL	**6**	**7**	**6**	**9**	
	%	**21**	**25**	**21**	**33**	**100**

In order for the test items of the research instruments to be appropriate for this research, the test items were firstly checked for its validity as follows:

a. Validity

Validity is the appropriateness, meaningfulness, correctness, and usefulness of an implication made by a researcher. It is the evidence gathering and analyzing the process to support inferences (Fraenkel, Wallen & Hyun, 2011). The type of validity which would be used in this study is the content validity, to determine the number of validity; it is done with the product moment correlation equation as follows:

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

(Freankel, Wallen,&Hyun, 2011)

Where,

r_{xy} = correlation coefficient between variable X and Y

N = number of test-takers

$\sum X$ = number of Test Items

$\sum Y$ = total score of test items

$\sum XY$ = multiplication of items score and total score

$\sum X^2$ = quadrate of number of test items

$\sum Y^2$ = quadrate of total score of test items

The above formula can be used to determine test item validity. The Table 3.4 can be used interpret the validity of each item.

Table 3.4
Reliability Interpretation

Gained r value	Interpretation
0.80 – 1.00	Very high
0.60 – 0.79	High
0.40 – 0.59	Medium
0.20 – 0.39	Low
0.00 – 0.19	Very low

(Jacobs and Chase, 1992)

b. Reliability

Reliability refers to the consistency of the result obtained, how accurate they are for each individual from one administration of an instrument to another (Freankel et al., 2012). The Kuder-Richardson Approach is the most important method for determining internal consistency. The letter formula consists of three pieces of information; there are is the number of item on the test, standard deviation and the mean.

$$KR21\ reliability\ coefficient = \frac{K}{K-1}\left(1 - \frac{M(K-M}{K(SD^2)}\right)$$

(Freankel, Wallen & Hyun, 2011)

K = Number of item on the test

M = Mean of the set on the test of the scores

SD = Standard deviation on the set of the scores

The implementation of reliability is shows in the Table 3.5

Table 3.5
Interpretation Reliability Coefficient

Gained r value	Interpretation
0.80 – 1.00	Very high
0.60 – 0.79	High
0.40 – 0.59	Medium
0.20 – 0.39	Low
0.00 – 0.19	Very low

(Jacobs and Chase, 1992)

c. Difficulty Level

The difficulty level in this research refers to the degree of difficulties for students to answer the questionnaire that are not from a teacher's perspective. The difficulty level is the difficulty of an item that proportion of the person who answers correctly of test item. To achieve an item's difficulty level, the number of learners or respondents with the correct answer divided by the total number of students or respondents. The formula that would be used to find the difficulty level shows in below

$$Pi = \frac{Ai}{Ni}$$

Where:

Pi = Difficulty Level

Ai = Number of students who answer correctly

Ni = Total number of student

Table 3.6
Categories of Difficulty Index

Difficulty Index Value (Pi)	Category
0.00 – 0.30	Difficult
0.31 – 0.70	Moderate
0.71 – 1.00	Easy

(Arikunto, 2013)

d. Discriminating Power

Discriminating power is provide information about individual differences either on the purportedly measured by the test. The aim is to identify items which high-scoring examines high-scoring examinations have a high possibility of answering correctly and low-scoring examinations have a low

possibility of answering correctly. Once the upper and lower groups have been identified the index discriminating (D) is computed as:

$$D = P_u - P_1$$

((*Backhoff, Larrazolo, & Rosas, 2000*)

Table 3.7
Discriminating power of the answer according to their D value

D =	Quality	Recommendations
>0.39	Excellent	Retain
0.30 – 0.39	Good	Possibilities for improvement
0.20 – 0.29	Medium	Need to check / review
0.00 – 0.28	Poor	Discard or review in depth
< -0.01	Worst	Definitely discard

e. Distractor

Distractors are the wrong option provided in multiple choices, and learners should choose the correct option. There are usually four options in each multiple choice question.

$$corrected\ score = R - \frac{W}{n-1}$$

(Kaplan and Saccuzo, 2012)

Where,

R = number of right answers

W = number of wrong answers

n = number of choice in each item

3.6.4 Questionnaire

To see the enhancement of students' motivation, the students used questionnaire of motivation that was adopted by Keller's ARCS model in 1987. The ARCS model describes four main major conditions which are Attention, Relevance, Confidence and Satisfaction that have to be met for individuals to become motivated and remain motivated. The data was analysed first to get the score of each students, researcher use Microsoft Excel 2013 to analyse all the data. The second is calculating the average after learning activity to analyze the

enhancement by calculating the N-Gain. Therefore the categorize of the questionnaire result is shows on Table 3.8

Table 3.8
The interpretation of scoring at Motivational Questionnaire

Score	Category
0% - 19.99%	Very (Disagree/Bad/ Less once)
20% – 39.99%	Disagree / Unfavorable
40% – 59.99%	Fair / Neutral
60% – 79.99%	Agree / Good / Like
80% - 100%	Very (Agree, Good Like)

(Darmadi, 2011)

Each of these situations subsumes several areas of Keller's psychological studies in 1979 and 1983 and was categorized into specific subcategories with sample motivation strategy prescription Students filled out the questionnaire after learning activity. The categorize of statement will be presented on the Table 3.9

Table 3.9
Classification in Motivation Questionnaire Based on ARCS Model

Conditions	The Sub-Conditions	The Indicator Strategies
Attention	A1 : Incongruity, Conflict	A1.1 Introduce a fact that seems to contradict the learner's past experience. A1.2 Present an example that does not seen to exemplify a given concept. A1.3 Introduce two equally plausible facts or principles, only one of which can be true. A1.4 Play devil's advocate.
	A2 : Concreteness	A2.1 Show visual representations of any important object or set of ideas or relationships. A2.2 Give examples of every instructionally important concept or principle. A2.3 Use content-related anecdotes, case studies, biographies, etc.
	A3 : Variability	A3.1 In stand up delivery, vary the tone of your voice, and use body movement, pauses, and props. A3.2 Vary the medium of instruction (platform delivery, film, video, print, etc.) A3.3 Vary the medium of instruction (platform delivery, film, video, print, etc.) A3.4 Break up print materials by use of

Conditions	The Sub-Conditions	The Indicator Strategies
		white space, visuals, tables, different typefaces, etc.
		A3.5 Change the style of presentation (humorous-serious, fast-slow, loud-soft, active-passive, etc.)
		A3.6 Shift between student-instructor interaction and student-student interaction.
	A4 : Humor	A4.1 Where appropriate, use plays on words during redundant information presentation.
		A4.3 Use humorous introduction.
		A3.3 Use humorous analogies to explain and summarize.
		A5.1 Use creativity techniques to have learners create unusual analogies and associations to the content.
	A5 : inquiry	A5.2 Build in problem solving activities at regular intervals.
		A5.3 Give learners the opportunity to select topics, projects and assignments that appeal to their curiosity and need to explore.
	A6 : Participation	A6.1 Use games, role plays, or simulations that require learner participation.
		R1.1 state explicitly how to use the introduction
	R1 : Experience	R1.2 Use analogies familiar to the learner from past experience.
		R1.3 Find out what the learners' interests are and relate them to the instruction.
	R2 : Present Worth	R2.1 State explicitly the present intrinsic value of learning the content, as distinct from its value as a link to future goals.
Relevant		R3.1 State explicitly how the instruction relates to future activities of the learner.
	R3 : future Usefulness	R3.2 Ask learners to relate the instruction to their own future goals (future wheel).
	R4 : Need Matching	R4.1 To enhance achievement striving behavior, provide opportunities to achieve standards of excellence under conditions of moderate risk.

Conditions	The Sub-Conditions	The Indicator Strategies
		R4.2 to make instruction responsive to the power motive, provide opportunities for responsibility authority, and interpersonal influence.
		R4.3 to satisfy the need for affiliation, establish trust and provide opportunities for no-risk, cooperative interaction.
	R5 : Modeling	R5.1 Bring in alumni of the course as enthusiastic guest lecturers.
		R5.2 In a self-paced course, use those who finish as deputy tutors.
		R5.3 Model enthusiasm for the subject taught.
	R6 : Choice	R6.1 Provide meaningful alternative methods for accomplishing a goal.
		R6.2 Provide personal choices for organizing one's work.
	C1 : Learning	C1.1 Incorporate clearly stated, appealing learning goals into instructional materials.
		C1.2 Provide self-evaluation tools which are based on clearly stated goals.
		C1.3 Explain the criteria for evaluation of performance.
	C2 : Difficulty	C2.1 Organize materials on an increasing level of difficulty; that is, structure the learning material to provide a "conquerable" challenge.
	C3 : Expectations	C3.1 Include statements about the likelihood of success with given amounts of effort and ability.
Confidence		C3.2 Teach students how to develop a plan of work that will result in goal accomplishment.
		C3.3 Help students set realistic goals.
	C4 : Attributions	C4.1 Attribute student success to effort rather than luck or ease of task when appropriate.
		C4.2 Encourage student efforts to verbalize appropriate attributions for both successes and failures.
	C5: Self-Confidence	C5.1 Allow students opportunity to become increasingly independent in learning and practicing a skill.
		C5.2 Have students learn new skills under low high risk conditions, but practice performance of well-learned

Conditions	The Sub-Conditions	The Indicator Strategies
		tasks under realistic conditions. C5.3 Help students understand that the pursuit of excellence does not mean that anything short of perfection is failure; learn to feel good about genuine accomplishment
	S1 : Natural Consequences	S1.1 Allows a student to use a newly acquired skill in a realistic setting as soon as possible. S1.2 Verbally reinforce a student's intrinsic pride in accomplishing a difficult task. S1.3 Allow a student who masters a task to help others who have not yet done so.
	S2 : Unexpected Rewards	S2.1 Reward intrinsically interesting task performance with unexpected, non-contingent rewards. S2.2 Reward boring task with extrinsic, anticipated rewards.
Satisfaction	S3 : Positive Outcome	S3.1 Give verbal praise for successful progress or accomplishment. S3.2 Give personal attention to students. S3.3 Provide informative, helpful feedback when it is immediately useful. S3.4 Provide motivating feedback (praise) immediately following task performance.
	S4 : Negative Influence	S4.1 Avoid the use of threats as a means of obtaining task performance. S4.2 Avoid surveillance (as opposed to positive attention). S4.3 Avoid external performance evaluations whenever it is possible to help the student evaluate his or her own work.
	S5 : Scheduling	S5.1 Provide frequent reinforcements when a student is learning a new task. S5.2 Provide intermittent reinforcements as a student becomes more competent at a task. S5.3 Vary the schedules of reinforcements in terms of both interval and quantity.

(*Keller, 1987*)

The statements that attached in the questionnaire, it will be 22 statements for the details list of statement the appear on the questionnaire that distributed to the experiment class can be seen on Table 3.10

Table 3.10
Questionnaire Sheet

No	Statement	Likert scale			
		Strongly disagree	Disagree	Agree	Strongly Agree
1	I am enthusiastic when I studied topic of food additives substances used quartet card games				
2	I do not know the difference natural and synthetic food additives substance material contained in quartet card games				
3	I can answer difficult questions about food additives substance				
4	The rules applied in learning quartet card games are so difficult, so I cannot follow them until finished the game				
5	After studying food additive substances, I care more about what I eat				
6	I want to participate in learning food additives substance used quartet card game and implemented the rules				
7	I think learn food additives substance used quartet card game is difficult to understand				
8	I know how to anticipate in using harmful additive substance after learning it used quartet card games				
9	After learning about food additives using quartet card games, I become more careful about what I consume				
10	I think learn food additives substances used quartet card game is useful because it is related in daily life				
11	I feel bored when learned food additives substances used quartet card game				
12	Learned used quartet card games is pointless and wasted time				

No	Statement	Likert scale			
		Strongly disagree	Disagree	Agree	Strongly Agree
13	I do not think there is has connection between learning objectives and quartet card games				
14	I am sure will get good score after taking part in learning food additives substances using quartet card games,				
15	Through quartet card game, I have learned how to fix issues that arise so that I can know more about my self				
16	Through the quartet card games, I discovered that victory must be diligent and cautious				
17	I feel satisfied when my friends accept my idea in learning food additive substances.				
18	I am pleased to help my friends who have troubles answering question on the quartet card game				
19	I am encouraged to understand food additives substances used quartet card game				
20	The quartet card games make me understand the topic quicker because I was able to enjoy learning while playing				
21	After played quartet card game, I am only played and did not get much information that can enhance the understanding about food additive				
22	After studying the food additives substance used quartet card games, I will not retain the additives substance when I consume food				

3.7 Research Instrument Judgment

In this study, the data obtained by pretest and posttest. Meanwhile, to measure student motivation is based on the questionnaire by using ARCS model (Attention, Relevant, Confidence and Satisfaction) in learning food additives

substances. For qualitative data students' conceptual understanding results are obtained. Based on the results of the study, data processing follows the diagram that has been made

3.7.1 Objective Test Validation

The objective test could be evaluated the improvement students conceptual understanding used pretest and posttest. It requires be assessed by validity, reliability, difficulty level, discriminating power and distracting power before the objective test should implement in experiment class. Therefore, the following 40 multiple choice question could be validated to a class that have been learned food additives substance. The samples that applied are 45 samples in 8th grade of Madania School. The recapitulation of Validation checked on Table 3.11

Table 3.11
Recapitulation of Test Items Validation

No	Aspect	Interpretation	Number of Test Item
1	Discriminating Power	Excellent	2, 4, 5, 7, 10, 11, 15, 16, 17, 19, 21, 22, 23, 27, 29, 30, 31, 33, 35, 36, 37, 38, 40
		Good	1, 9, 12, 13, 28
		Medium	8
		Poor	3, 6, 14, 20, 24, 25, 26, 32, 34
		Worst	18
2	Difficulty Level	Very Difficult	
		Difficult	1, 2, 4, 6, 7, 9, 10, 13, 14, 15, 16, 17, 18, 19, 20, 23, 24, 25, 35, 36, 37, 39, 40
		Medium	3, 5, 8, 11, 21, 22, 27, 29, 30, 31, 32, 33, 38
		Easy	12
		Very Easy	26, 28, 34
3	Validity	Very High	
		High	16, 23, 27
		Medium	2, 4, 5, 7, 10, 11, 12, 15, 17, 19, 21, 22, 29, 30, 31, 33, 35, 36, 37, 38
		Low	1, 8, 9, 13, 28, 40
		Very Low	3, 6, 14, 18, 20, 24, 25, 26, 32, 34, 39

No	Aspect	Interpretation	Number of Test Item
4	Sign. Correlation	Very Significant	2, 4, 5, 7, 10, 11, 12, 15, 16, 17, 19, 21, 22, 23, 27, 29, 30, 31, 33, 35, 36, 37, 38
		Significant	8, 9, 13, 28. 40
		NAN	1, 3, 6, 14, 18, 20, 24, 25, 26, 32, 34, 39
5	Decision	Used	2, 4, 5, 7, 8, 8, 10, 11, 12, 13, 15, 16, 17, 19, 21, 22, 23, 27, 28, 29, 30, 31, 33, 35, 36, 37, 38, 40
		Dropped	1, 3, 6, 14, 18, 20, 24, 25, 26, 32, 34, 39

From table 3.11 shows that the result of validation from students 8th grade. Based on aspect, the researcher decided to use 28 questions and dropped 12 questions from 40 questions. Based on this step, the validity test of the questions was already done, so the item test can be used and prepared to be applied to the experiment class.

3.7.2 Objective Test Categorization

Educational quartet card game is anticipated to obtain some score from pretest to posttest. The improvement (gain) from pretetst and posttest of participant could be calculated by subtracting. The categorization of improvement as present on the Table 3.12

Table 3.12
N-gain Categorization

No	N-gain (<g>)	Level of categorization
1	0.00 – 0.30	Low
2	0.31 – 0.70	Medium
3	0.71 – 1.00	High

(Hake, 1998)

1.7.3 Questionnaire

ARCS Motivational questionnaire by John Keller (1987) is consist of 22 statements in the form of Likert question which have negative statements and positive statements. The statement will distributes into four condition based on table 3.11, that separated into positive and negative statement. The data will be

collecting by the score of students give. The range of the score it will divided into 1 until 4 (1 for strongly disagree, 2 for disagree, 3 for agree and 4 for strongly agree). The distribution table of statement present on Table 3.13

Table 3.13
Statement Distribution in Motivation Questionnaire

No.	Condition	Motivation Question	
		Number of Positive Statement	Number of Negative Statement
1.	Attention	1, 3, 5, 6	2, 4
2.	Relevant	8, 9, 10	7, 11, 12
3.	Confidence	14, 15, 16, 17	13
4.	Satisfaction	18, 19, 20	21, 22

1.7.4 Data statistical analysis

The experimental research needs data statistical analysis to prove the validity the result. The step of data statistical was obtained as follow:

1. Quantitative Data Processing

Quatitative data analysing was calculates to determine the pretest and posttest rating. The calculation methods are describes as follows:

a. Scoring of Test Item

The first step to process the data was by scoring the test item which consists of 25 questions. To find the Gain and Normalized Gain, the researcher give scoring for objectives test 0 (zero) and 1 (one), 0 for incorrect answer and 1 for correct answer.

b. Calculation of Gain Score and Normalized Gain

After student's result of pretest and posttest was compiled, gain score is calculated by determines the differences of pretest and posttest score. The researcher can analyze the media or model learning to the improvement students' conceptual understanding. The next step is categorized N-Gain of students achievement. To calculate the objective test, the researcher used the formula by Hake, as follows:

$$G = S_f - S_i$$

(*Hake, 1998*)

Where,

G = Gain Score

S_f = Posttest Score

S_i = Pretest Score

The result of N-Gain can be shows the result of the effect of Educational Quartet Card Games Learning on students' conceptual understanding in learning food additive substances. The formula which used to calculate normalized gain regarding Hake (1998) is:

$$< g >= \frac{\%G}{\%Gmax} = \frac{\%S_f - \%S_i}{100 - \%S_i}$$

Where,

<g> = Normalized gain

G = Actual gain

Gmax = Maximum gain possible

S_f = Post - test score

S_i = Pre - test score

Average of normalized gain (<g>) which is formulated as:

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

Where,

<g> = Normalized gain

<G> = Actual gain

<G>max = Maximum gain possible

$<S_f>$ = Average of post test score

$<S_i>$ = Average of pretest score

The value of Normalized gain that has been gained is interpreted using an interpretation table as follows:

Table 3.14
Interpretation of Normalized Gain

Value	Classification
$\langle g \rangle \geq 0.7$	High
$0.7 > \langle g \rangle \geq 0.3$	Medium
$\langle g \rangle < 0.3$	Low

(Hake, 1988)

c. Normality

The normal distribution is determined by referring to the significant value of Shapiro-Wilk which has been approved for effectiveness in measuring normality even for small size sample (n<20) (Shapiro and Wilk, 1965). The level significance of Kolmogorov-Smirnov is 0.05 it means if the result show on level 0.05 H_0 will accepted, while the result shows value >0.05 is rejected. In addition, the purpose of the normality test is to know the data distributed has normal result or not. The hypothesis that has been verified should be arranged following:

H_o: There is no difference on students' conceptual understanding and students' motivation in learning food additives substances using Educational Quartet Card Game based learning

H_1: There is no difference on students' conceptual understanding and students' motivation in learning food additives substances using Educational Quartet Card Game based learning.

d. Independent Sample T-Test

To measure the hypothesis the researcher should T-test that used. This test was conduct after normality test of data. T-test used after knows the data distribute normally. If the result of level significance (sig) ≤0.05 which means H_0 rejected but if, (sig) >0.05 means H_o accepted.

2. Qualitative Data Processing

This qualitative data processing was pointed to data analysis for students' motivation. In this processing of the data, analyzed by Microsoft excel. There are 22 statements with 4 number of Likert-scale that student can choose. The

statement classifies into four, attention, relevance, confidence and satisfaction based on Keller. The statement also divided into positive and negative statements and for each statement has different score. The score for each statement that give shows in Table 3.15 below:

Table 3. 15
Scoring Guidelines Likert-scale score

Statements	Strongly Agree	Agree	Disagree	Strongly Disagree
Positive	4	3	2	1
Negative	1	2	3	4

1.8 Research Procedure

The procedure in this study is divided into three stages which are preparation stage, implementation stage and completion stage. Each stage has different activities that conducted during the study.

3.8.1 Preparation Stage

The preparation stage is the first step to begin the process of this study, there were several steps are containing in the preparation stage as follows:

a. Analyze the process of teaching and learning
b. Analyze the curriculum
c. Analyze the educational quartet card game
d. Analyze the student conceptual understa
e. Analyze the student motivation
f. Determine the sample and population
g. Making the educational quartet card game
h. Making the research instruments

1.8.2 Implementation Stage

This stage consist of the data gathering process which includes several steps as follows:

a. For the initial condition is conducted a pretest to measure student prior knowledge
b. Analyze pretest results.
c. Applied the educational quartet card game to experiment class.
d. To measure the effect by the treatment is conducted post-test.

e. Given the posttest to participant
f. Students fill the questionnaire to measure students' motivation
g. Analyze the post-test and questionnaire

1.8.3 Completion Stage

The last step procedure of this study is completion stage. In this steps are containing as follows:

a. Analyzed the data of the whole research
b. Conclude the hypothesis
c. Arrange the report of this study

1.9 Research Flowchart

The flowchart of the research is showing the flow how is the research is conducted. It starting from the preparation stage, the implementation stage, and at the end is the completion stage. More of the detail of the research flowchart will be present as the Figure 3.1

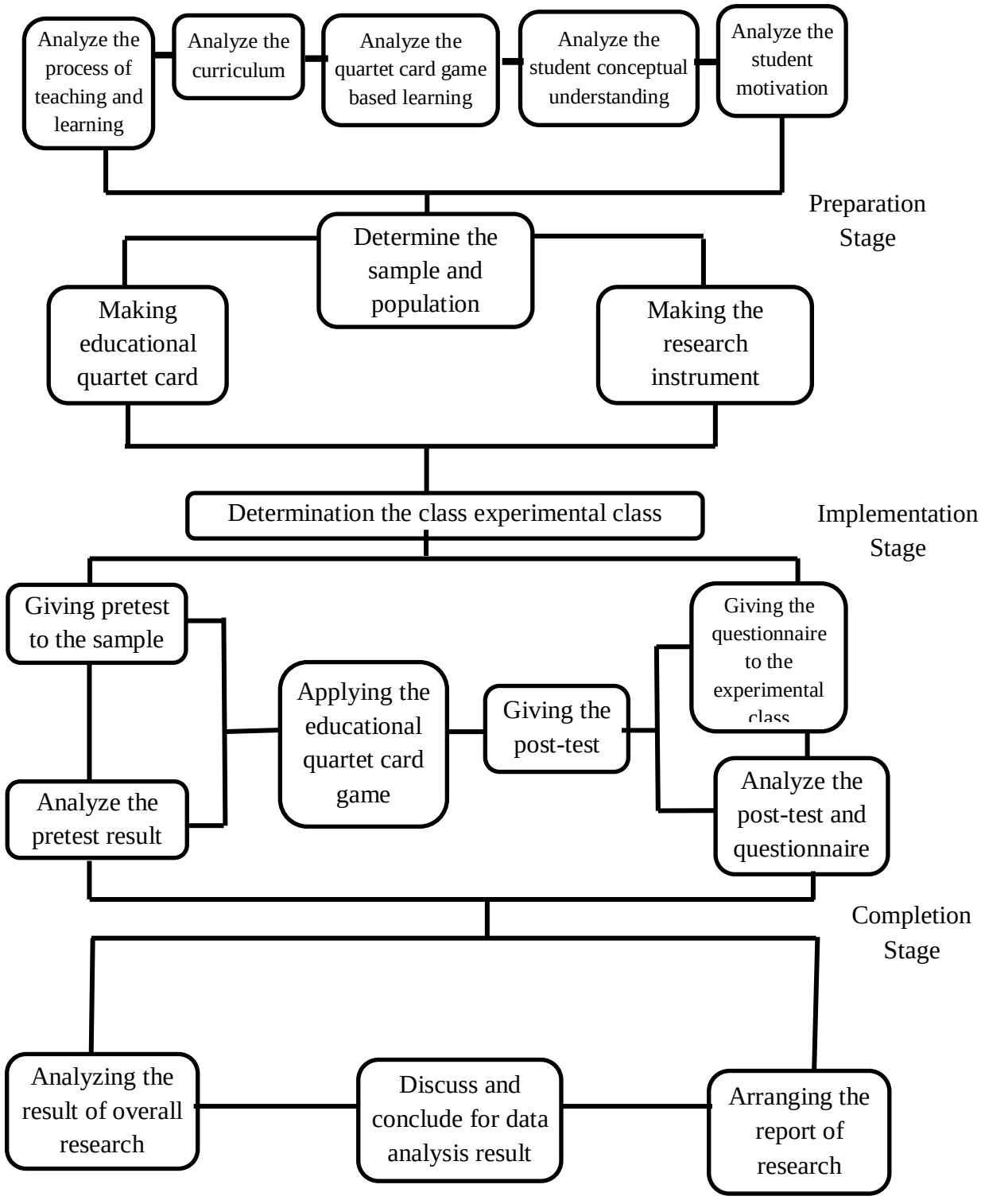

Figure 3.1 Diagram of Research Scheme