CHAPTER III
RESEARCH METHODOLOGY

3.1 Research Method and Research Design

A research needs certain method and design to gain the expected result that would be benefit in enriching knowledge and the process of science learning conducted. Below explained on how the research method and research design used in the implementation of the research.

3.1.1 Research Method

The research method used is pre-experimental method to find out the certain effects of experiments towards variables (Cohen, Manion, & Morrison, 2007). This method enables to establish treatments and to study the impacts and results for further interpretations (Fraenkel, Wallen, & Hyun, 2012). The main aim of this study is to discover the leverage of info-graphic creating by using Genially towards student's scientific literacy and communication skill in climate change topic.

3.1.2 Research Design

The research design used is one group pretest-post-test design. It allows to investigate the differences score attained due to the experimental treatment from pre-test and post-test result towards one group. Additionally, it does not require the researcher to use random assignment of subjects to group. Students will be given a pretest to gain the information of their prior knowledge. After treatments, students are given posttest to be investigated whether or not there is desired changes on certain knowledge and skills (Cohen et al., 2007; Fraenkel et al., 2012).

3.2 Research Subjects

The population of this research was the 7th grade students with total 99 students in 4 classes in one of Private Junior High Schools in Cimareme, West Bandung which uses 2013 National Curriculum. The sampling method used is convenience sampling by considering its easy accessibility and availability during the study from home transition (Etikan, 2016). At the end, the total resulted available students were 50 since the rest did not follow the procedures of experiment implementations completely. The detail of the sample which classified based on its gender and accomplishment is explained in Table 3.1 as followed.

Table 3.1
Research Sample Details

Classification	Number of Sample	Percentage (%)
Gender		
Female	36	72
Male	14	28
Accomplishment		
High Achiever	19	38
Low Achiever	31	62

3.3 Operational Definition

In order to summarize and avoid any misconception about this research, the operational definitions are stated. The research variables are as followed:

1) Scientific literacy in this research includes students' ability assessment on competency domain and knowledge domain. As stated in PISA, scientific literacy is capability in using scientific and evidence-based knowledge on daily life with careful determination. In this research, students' scientific literacy is assessed using the objective test consists of 25 multiple choices on climate change topic which given before experiment implementation (pretest) and after experiment implementation (posttest).
2) Communication skill in this research involves two major competency areas such as verbal communication and visual communication with each specific skill components and activities. Students' communication skill is particularly

assessed using adopted rubric from previous related studies from the experts which covers four main skill components such as preparation and component, presentation and delivery, content generation, and visual design generation. The scoring rate starts from 1 (one) as unsatisfactory, 2 (two) as satisfactory, and 3 (three) as excellent.

3) Info-graphic in this research is the visual product created by the students to fulfill the competency area of visual communication skill. The info-graphic is generated using Genially website. Then students ought to explain the content of their info-graphics as the attainment of verbal communication skill. The process of organizing information and data to be visualized is also expected to take a part on scientific literacy's subdomain.

3.4 Hypothesis

Hypothesis that would be tested on this study are as followed:

a) H_0: There is no enhancement on students' scientific literacy by creating info-graphics using Genially in learning climate change.
   H_1: There is enhancement on students' scientific literacy by creating info-graphics using Genially in learning climate change topic.

b) H_0: There is no enhancement of students' communication skill by creating info-graphics using Genially in learning climate change topic.
   H_1: There is enhancement of students' communication skill by creating info-graphics using Genially in learning climate change topic.

3.5 Research Instruments

In this research, there are several instruments to be used which are objective test, rubric, and questionnaire. The instruments are explained as followed:

1) Objective Test

   Objective test is used to measure students' scientific literacy. The objective test will be given to students as pretest and posttest on climate change topic. The subtopic on climate change is divided into five parts in accordance with the National Curriculum of 2013. Furthermore, the competencies involve explaining phenomena scientifically, evaluating and designing scientific

enquiry, and interpreting data and evidence scientifically with considering content knowledge, procedural knowledge and epistemic knowledge which then covered into the subtopics of the whole coverage in climate change topic. The unrevised blueprint of scientific literacy test items on climate change topic is shown in Table 3.2.

Table 3.2
Blueprint of Scientific Literacy Objective Test
(Before Revision)

No.	Subtopic/Knowledge-Competencies	Explain phenomena scientifically			Evaluate and design scientific enquiry			Interpret data and evidence scientifically		
		C	P	E	C	P	E	C	P	E
1	Greenhouse effect	1,2,3	8	5			9, 10	4,6,7		
2	Global warming process	11,12,13, 14,16,18, 19,20			15			17		
3	The factors of global warming	21,22,23, 25,27,28, 30			26,29				2 4	
4	The impacts of global warming	31,35,37, 38,39,40		32		3 4		33,36		
5	Overcoming global warming	49		44,45, 46,50			43			41,42,47, 48

The test items were firstly judged by the experts and then validated by tested it to students that have already learned about climate change topic which is filled by 30 students from various Junior High Schools of 8th grader. The initial test items validation is conducted online due to distance learning. The resulted validation score from students then analyzed using ANATES V4 to find out its validity, reliability, difficulty level, discriminating power, and distractor. The validity of test items is represented in correlation between item score and total score. After being analyzed, it is resulted that the item reliability score is 0.92 which is categorized as very reliable (Ahdika, 2017). The recapitulation of test items analysis is presented in Table 3.3 as followed.

Table 3.3
Recapitulation Analysis of Scientific Literacy Test Items

Question Number	Discriminating Power (%)	Difficulty Level	Correlation	Significance Correlation	Acceptance	New Question Number
1	50.00	Medium	0.267	(-)	Revision	1
2	62.50	Medium	0.444	Very Significant	Accepted	2
3	12.50	Medium	0.128	(-)	Revision	-
4	12.50	Very Easy	0.359	Very Significant	Accepted	3
5	37.50	Medium	0.477	Very Significant	Accepted	4
6	0.00	Medium	0.258	(-)	Revision	-
7	0.00	Medium	0.078	(-)	Revision	-
8	37.50	Easy	0.417	Very Significant	Accepted	5
9	37.50	Medium	0.219	(-)	Revision	-
10	50.00	Medium	0.354	Very Significant	Accepted	-
11	12.50	Very Difficult	0.075	(-)	Revision	-
12	50.00	Difficult	0.34	Significant	Accepted	-
13	37.50	Medium	0.163	(-)	Revision	6
14	0.00	Easy	0.109	(-)	Revision	7
15	37.50	Medium	0.159	(-)	Revision	8
16	62.50	Medium	0.413	Very Significant	Accepted	9
17	-12.50	Very Difficult	0.032	(-)	Revision	-
18	37.50	Medium	0.359	Very Significant	Accepted	10
19	-12.50	Very Difficult	-0.072	(-)	Rejected	-
20	37.50	Easy	0.287	Significant	Accepted	-
21	37.50	Easy	0.484	Very Significant	Accepted	-
22	-12.50	Medium	-0.002	(-)	Rejected	-
23	25.00	Medium	0.234	(-)	Revision	-
24	75.00	Difficult	0.514	Very Significant	Accepted	11
25	50.00	Easy	0.391	Very Significant	Accepted	12
26	12.50	Easy	0.318	Significant	Accepted	13
27	37.50	Easy		Very Significant	Accepted	-
28	37.50	Very Easy	0.605	Very Significant	Accepted	-
29	37.50	Very Easy	0.566	Very Significant	Accepted	14
30	75.00	Medium	0.682	Very Significant	Accepted	15
31	50.00	Easy	0.358	Very Significant	Accepted	16
32	50.00	Difficult	0.489	Very Significant	Accepted	17

Question Number	Discriminating Power (%)	Difficulty Level	Correlation	Significance Correlation	Acceptance	New Question Number
33	0.00	Medium	0.083	(-)	Revision	-
34	25.00	Medium	0.175	(-)	Revision	18
35	-12.50	Medium	0.022	(-)	Revision	-
36	50.00	Easy	0.559	Very Significant	Accepted	19
37	62.50	Medium	0.463	Very Significant	Accepted	20
38	62.50	Medium	0.542	Very Significant	Accepted	-
39	50.00	Easy	0.441	Very Significant	Accepted	-
40	37.50	Medium	0.393	Very Significant	Accepted	-
41	12.50	Medium	0.225	(-)	Revision	-
42	25.00	Medium	0.238	(-)	Revision	-
43	75.00	Easy	0.691	Very Significant	Accepted	21
44	75.00	Easy	0.691	Very Significant	Accepted	22
45	25.00	Very Easy	0.488	Very Significant	Accepted	23
46	50.00	Medium	0.347	Significant	Accepted	24
47	25.00	Easy	0.287	Significant	Accepted	25
48	37.50	Medium	0.316	Significant	Accepted	-
49	62.50	Easy	0.611	Very Significant	Accepted	-
50	100	Medium	0.659	Very Significant	Accepted	-

The revision ones are considered to be used by considering the experts suggestions, competencies domain as well as subtopic distributions. The final test items resulted to be used then reduced into 25 multiple choices with recapitulation as followed. The details is attached on Appendix B.3.

Table 3.4
Blueprint of Scientific Literacy Objective Test
(After Revision)

No.	Subtopic/Knowledge-Competencies	Explain phenomena scientifically			Evaluate and design scientific enquiry			Interpret data and evidence scientifically		
		C	P	E	C	P	E	C	P	E
1	Greenhouse effect	1,2	5	4				3		
2	Global warming process	6,7,9,10			8			17		
3	The factors of global warming	12,15			13,14				11	
4	The impacts of global warming	16,20		17		18		19		
5	Overcoming global warming			22,23, 24			21			25

2) Questionnaire

Questionnaire is used to assess students' scientific literacy in attitude domain. Based on PISA, the aspects being considered are interest in science, valuing scientific approaches to enquiry, and environmental awareness. The questionnaire is adopted from PISA 2015 assessment and analysis framework by using Likert-scale. The blueprint of the questionnaire is shown as followed with details of used questionnaire is attached on Appendix B.4.

Table 3.5
Blueprint of Scientific Literacy Questionnaire (Attitude Domain)

No.	Indicators	Likert Scale				
		1	2	3	4	5
	Interest in Science					
1	**Interest in Learning Science**: A measure of how much interest students have in learning about physics, human biology, geology and the processes and products of scientific enquiry					
2	**Enjoyment of Science**: A measure of how much students like learning about science both in and out of school					
3	**Future Orientated Science Activities**: A measure of the level of interest students have in pursuing scientific careers or the study of science after school					
4	**Instrumental Motivation to Learn**: A measure of the extent to which a students' motivation to learn science is extrinsically motivated by the opportunities science offers for employment					
5	**General Value of Science**: A measure of how much prestige the student holds about a range of different careers including scientific ones					
6	**Self-Efficacy in Science**: A measure of how able the student perceives they are at science					
7	**The Occupational Prestige of Specific Careers**: A measure of how valuable the student sees science to be for him or herself					
8	**Use of Technology**: A scale that measures how adolescent approach and use new technology					

No.	Indicators	Likert Scale				
		1	2	3	4	5
9	**Out-of-School Science Experiences**: A measure of the range of extra-curricular and out- of-school science activities that students engage in					
10	**Career Aspirations**: A broad measure of the disposition that students have towards scientific careers					
11	**School Preparation for Science Career**: A measure of how well the student feels that their formal science education and school has provided them with the knowledge and skills needed for a scientific career					
12	**Student Information on Science Career**: A measure of how well-informed the student feels that they area about possible science careers					
	Valuing Scientific Approaches to Enquiry					
1	A commitment to evidence as the basis of belief for explanations of the material world					
2	A commitment to the scientific approach to enquiry when appropriate					
3	A valuing of criticism as a means of establishing the validity of any idea					
	Environmental Awareness					
1	**Awareness of environmental issues**: A measure of how informed students are about current environmental issues					
2	**Perception of environmental issues**: A measure of how concerned students are about environmental issues					
3	**Environmental optimism**: A measure of students' belief that their or human actions can contribute to sustaining and improving the environment					

(Source: OECD, 2017b)

The scientific attitude questionnaire applied in this research measured using Likert scale. Likert scale is arranged in order to measure "attitude" which is scientifically accepted (Joshi, Kale, Chandel, & Pal, 2015). The scale was stated in number from 1 to 5 which starts from strongly disagree to strongly agree.

Table 3.6
Likert Scale of Scientific Attitude Questionnaire

Scale	Criterion	Point
1	Strongly Disagree	1
2	Disagree	2
3	Neutral	3
4	Agree	4
5	Strongly Agree	5

Table 3.6 informs that each scale is representing a criterion on gaining the value of scientific attitude domain in scientific literacy. Scale 1 means that student is strongly disagree on the statement and attain 1 point from the determined choice. In order to make sure the questionnaire is proper to be implemented, the questionnaire is being judged by experts with specific background in education and particularly in science education. The initial questionnaire consists of 18 statements but then added with 2 more statements alongside with the suggestions from the expert. Results of judgment from the experts consists of grammatical error, additional aspects, as well as the needs for more information.

Table 3.7
Statements Revision from Expert Judgment

Revision	Statement Number
Grammatical error	1, 3, 6, 17, 19, 20
Additional aspects	13, 14, 15, 16, 17, 18, 19, 20
Needs for more information	5, 8, 13, 18

Table 3.7 explains the revision that needed to be done towards the questionnaire. From the grammatical error, the experts were asking for proper arrangement of sentences and the suggestions to simplify the languages being used in the statements so that it would ease students to understand better. Then from additional aspects, the experts were asking to complete the questionnaire statements with

additional sources related to the aspect to be valued. Meanwhile for the revision in the needs for more information indicates that the previous statements were too general and needs to be more specific. The details of the instrument judgments are attached in Appendix B.1.

3) Rubric

Rubric is used to measure students' communication skill visually and verbally through the implementation of info-graphics in class. The rubric is adopted from Morreale et al., 2007; Schrock, 2012; Kibar & Akkoyunlu, 2017. The details of the rubric blueprint is shown in Table 3.8

Table 3.8
Blueprint of Communication Skill Rubric

Competency Area/Skill Component	Activities	Level of Achievement		
		Excellent 3	Satisfactory 2	Unsatisfactory 1
Verbal Communication/ Preparation and Component	Chooses and narrows a topic appropriately for the audience and occasion	Student presents a topic and a focus that are exceptionally appropriate for the purpose, time constraints, and audience.	Student presents a topic and a focus that are appropriate for the purpose, time constraints, and audience.	Student presents a topic and a focus that are not appropriate for the purpose, time, the constraints or audience.
Verbal Communication/ Preparation and Component	Communicates the thesis/specific purpose in a manner appropriate for the audience and occasion	Student communicates a thesis/specific purpose that is exceptionally clear and identifiable.	Student communicates a thesis/specific purpose that is adequately clear and identifiable.	Student does not communicate a clear and identifiable thesis/specific purpose
Verbal Communication/ Preparation and Component	Provides appropriate supporting material	Student uses supporting material that is exceptional in quality and variety.	Student uses supporting material that is appropriate in quality and variety.	Student uses supporting material that is inappropriate in quality and variety.
Verbal Communication/ Preparation and Component	Uses an organizational pattern appropriate to the topic, audience,	Student uses an exceptional introduction and conclusion and provides	Student uses an appropriate introduction and conclusion and provides a reasonably	Student fails to use an introduction or conclusion and fails to provide a

Competency Area/Skill Component	Activities	Level of Achievement		
		Excellent 3	Satisfactory 2	Unsatisfactory 1
	occasion, and purpose	an exceptionally clear and logical progression within and between ideas.	clear and logical progression within and between ideas.	reasonably clear and logical progression within and among ideas.
Verbal Communication/ Presentation and Delivery	Uses language appropriate to the audience and occasion	Student uses language that is exceptionally clear, vivid, and appropriate.	Student uses language that is reasonably clear, vivid, and appropriate.	Student uses unclear or inappropriate language.
Verbal Communication/ Presentation and Delivery	Uses of vocal variety in rate, pitch, and intensity (volume) to heighten and maintain interest appropriate to the audience and occasion	Student makes exceptional use of vocal variety in a conversational mode.	Student makes acceptable use of vocal variety in a conversational mode.	Student fails to use vocal variety and fails to speak in a conversational mode.
Verbal Communication/ Presentation and Delivery	Uses pronunciation, grammar, and articulation appropriate to the audience and occasion	Student has exceptional articulation, pronunciation, and grammar.	Student has acceptable articulation, with few pronunciation or grammatical errors.	Student fails to use acceptable articulation, pronunciation, and grammar.
Verbal Communication/ Presentation and Delivery	Uses physical behaviors that support the verbal message	Student demonstrates exceptional posture, gestures, bodily movement, facial expressions, eye contact, and use of dress.	Student demonstrates acceptable posture, gestures, facial expressions, eye contact, and use of dress.	Student fails to use acceptable posture, gestures, facial expressions, eye contact, and dress.
Visual Communication/ Content Generation	Chooses the topic to be informed	The topic of the info-graphic is specific in nature and is intended to	The topic of the info-graphic may be a bit too broad to allow the viewer to	The topic of the info-graphic is hard to ascertain and needs to be

Competency Area/Skill Component	Activities	Level of Achievement		
		Excellent 3	Satisfactory 2	Unsatisfactory 1
		inform or convince the viewer.	understand the main points.	made more specific.
Visual Communication/ Content Generation	Chooses type of info-graphics template	The type of info-graphic chosen (i.e. timeline, informational, etc.) highly supports the content being presented.	The type of info-graphic chosen represents the content being chosen but another type may lead to more clarity for the viewer.	The type of info-graphic chosen does not convey the information well or support the content being presented.
Visual Communication/ Content Generation	Uses of layout to present the information	The layout of the info-graphic adheres to the inverted pyramid style - main point on top, secondary point next, and supporting details at the bottom.	The layout of the info-graphic includes all three components - main point, secondary point, and supporting details - but is not organized in the inverted pyramid style.	The info-graphic is lacking one or two of the components of good infographic design - main point, secondary point, or supporting details.
Visual Communication/ Content Generation	Organizes the flow of information	The info-graphic utilizes one of the LATCH (location, alphabetical, timeline, category, or hierarchy) information organization formats to allow the viewer to understand the information in the infographic.	The info-graphic utilizes some components of the LATCH (location, alphabetical, timeline, category, or hierarchy) information organization formats, but the cohesiveness of the information presentation is lacking.	No information organization choice (location, alphabetical, timeline, category, or hierarchy) is present in the infographic.
Visual Communication/ Content Generation	Cites the references	Full bibliographic citations for all sources	The URL of sources used are included.	No citations to sources used are included.

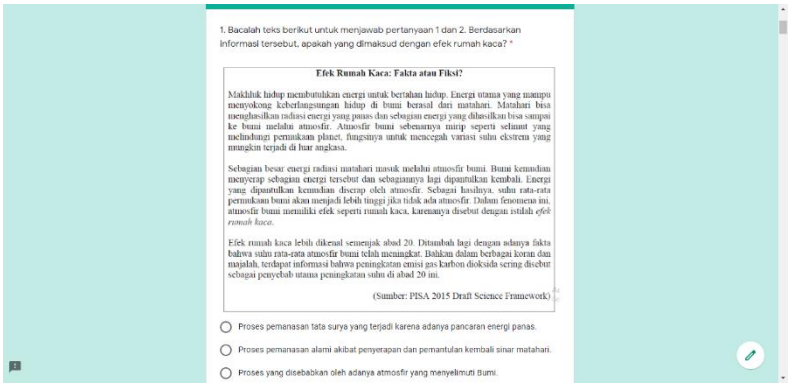
Competency Area/Skill Component	Activities	Level of Achievement		
		Excellent 3	Satisfactory 2	Unsatisfactory 1
		used are included.		
Visual Communication/ Visual Design Generation	Uses of objects or other elements to support the information delivery	The objects included in the info-graphic are repeated to support various data points and to make it easier for the viewer to understand the infographic.	Some objects included in the infographic are repeated but the info-graphic did not seem to include enough repeated elements to make it understandable.	Too many different types of objects are used in the info-graphic and that makes it hard for the viewer to understand the content.
Visual Communication/ Visual Design Generation	Uses of data visualization	The data visualization formats chosen make the data presented easy for the viewer to understand the information.	The data visualization formats chosen showcase the data, but some may make it difficult for the viewer to understand the points.	Other data visualization formats should be chosen to best showcase the data presentation for the viewer.
Visual Communication/ Visual Design Generation	Uses of fonts for the writing	The info-graphic includes an appropriate font to both complement the content and make the text readable.	The infographic includes multiple fonts and/or the fonts do not seem related to the info-graphics topic.	The font(s) used in the info-graphic make the text almost unreadable.

(Source: Morreale et al., 2007; Schrock, 2012; Nuhoğlu Kibar & Akkoyunlu, 2017)

3.6 Data Collection

Scientific Literacy data of students in "X" Junior High School were collected through online forms. For students' scientific literacy in terms of competency and knowledge domains have been covered in the objective test while for attitude domain is covered in a questionnaire. Moreover, students' communication skill data is shared online using a social media platform.

Scientific literacy objective test and questionnaire addressed to students have been translated to Bahasa Indonesia due to students' capability to understand the questions and statement is more excellent in Bahasa rather than in English. Figure 3.1 displays the online form.



(a)

(b)

Figure 3.1 (a) The display of objective test online form, (b) the display of questionnaire online form

Furthermore, students' result of info-graphic and performance in explaining the content of their own info-graphic is shared online using Instagram social media platform. Instagram is used because of its easy accessibility for both students and the researcher. Besides, it can be viewed multiple times and given certain sections for giving comments or feedback. The figure 3.2 below displays the example of the posted students' work.

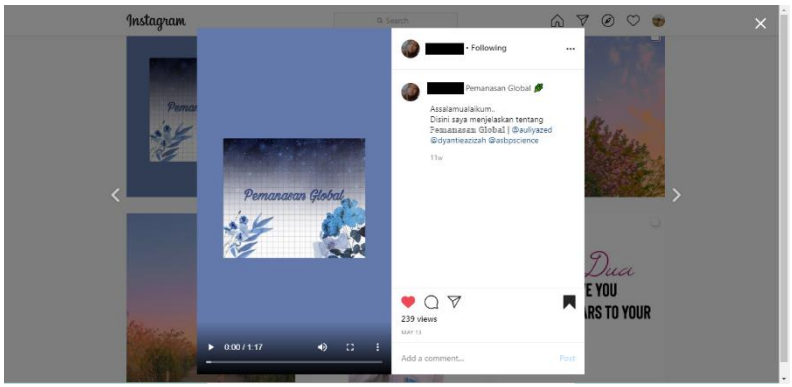


Figure 3.2 Students' online post to collect communication skill data

Figure 3.2 displays one of students' work as a mean to gather communication skill data. After students are all completing their posts, the researcher reviewed and assess the verbal communication skill and visual communication skill using a rubric that has been adopted.

3.7 Research Procedure

Research procedures of this study are arranged into three stages following an order of systematic research. The three arrangements include preparation stage, implementation stage, and completion stage.

3.7.1 Preparation Stage

The preparation stage includes the relevant search from various sources related to scientific literacy, communication skill, info-graphics and the appropriate website to generate the visual product. Then the topic focus is determined to maximize the experiment implementation of info-graphics using in learning process. In addition, the instruments used to assist students' attainment is considered with objective test, questionnaire and rubric which then judged by the experts and validated before given to the students.

3.7.2 Implementation Stage

The implementation of experiment was conducted to obtain the data from students' attainment. The complete learning activities can be seen in Appendix 1. The learning process was taken place online in Edmodo for the instructions, then in Google Meet for the tutorial display of using Genially website and introductory to the basics of info-graphics, and Instagram as a mean for students to compile their created info-graphics and video performances. The following table presents the steps in conducting the experiment.

Table 3.9
Implementation Stages of Info-graphics Creating

Meetings	The Activities
1st meeting	1. Students are given the instructions to learn objectives on new topic. 2. Students are given pretest for both scientific literacy and communication skill using objective test and rubric. 3. Students are given an introductory video and brief explanations about the new topic. 4. Students are given the instructions to prepare for the upcoming activities.
2nd meeting	1. Students are divided into five groups based on the subtopics. 2. Students are given guideline to create info-graphics. 3. Students determined the type and layout of info-graphics to be used. 4. Students searched the content for the info-graphics from textbooks and other reliable online sources. 5. Students are given the tutorial to use Genially website. 6. Students created the info-graphics that have been designed and recorded their explanations to be uploaded online on personal Instagram accounts.
3rd meeting	1. Students completed all the works and given feedback of their works by teacher. 2. Students are given posttest on scientific literacy and communication skill.

3.7.3 Completion Stage

During this final stage, the obtained data are then analyzed and reported in a research paper. The data are analyzed statistically and the result are then

discussed with the research supervisors and the research paper is completed. The whole process of the research procedures is summarized into the flowchart as seen in Figure 3.3

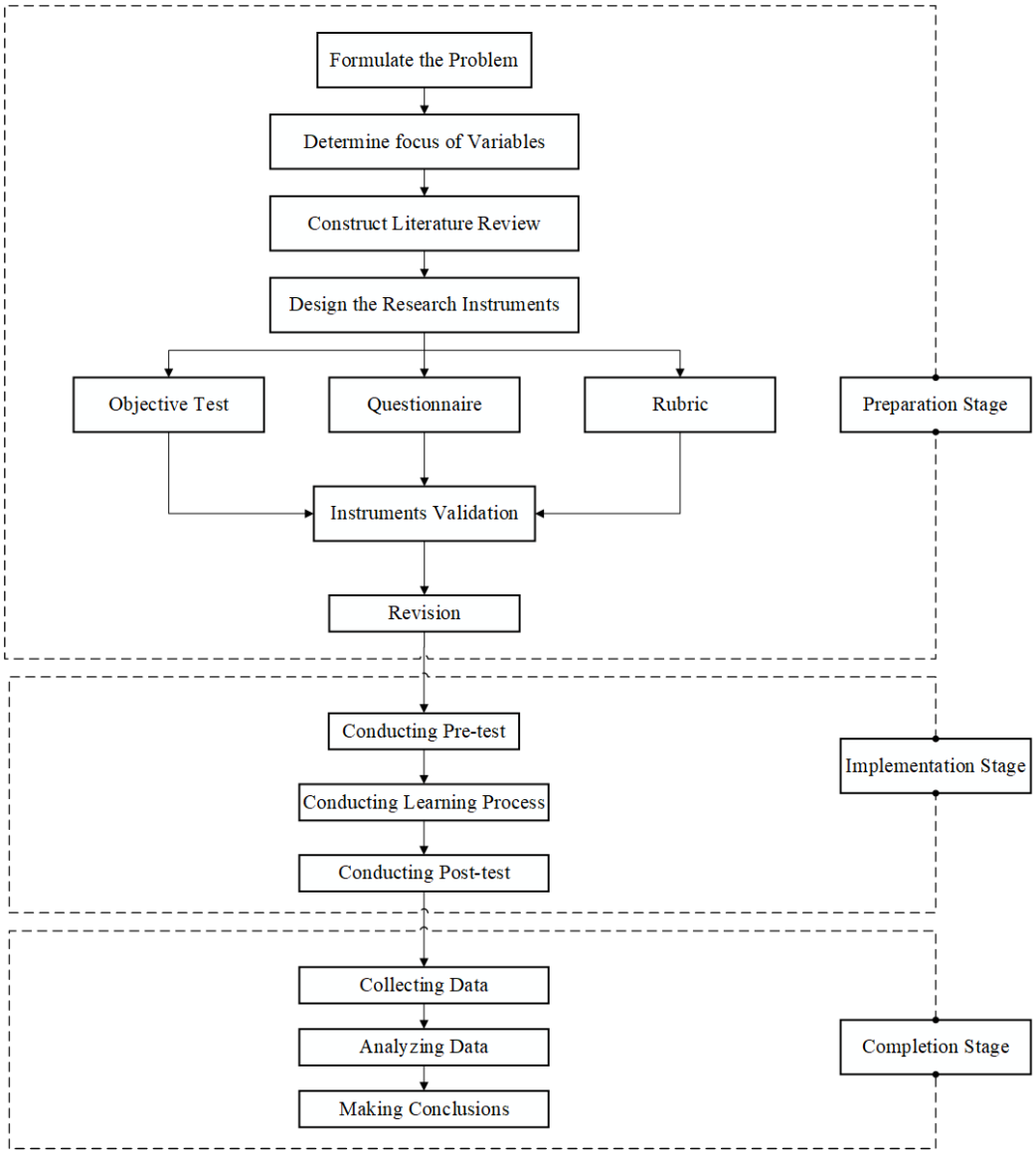


Figure 3.3 Flowchart of Research Stages