CHAPTER III
RESEARCH METHODOLOGY

3.1 Research Design

This is a mixed methods design, specifically an embedded design. The goal of the embedded design is to gather simultaneously or sequentially quantitative and qualitative data, in which one type of data support other type of data. The second type of data is gathered to complements or supports the first type of data (Creswell, 2012). In order to have a deeper knowledge of the situation, a combination of qualitative and quantitative research can achieve more comprehensive understanding (Guetterman & Fetters, 2018). The benefits of both quantitative and qualitative data are combined in this design, and this becoming the strength of this research. In contrast to recognizing through qualitative data how individuals are feeling the process, quantitative data are more successful for tracking experiment outcomes (Creswell, 2012). In the social and behavioral sciences, mixed methods research, which specifically tries to provide a framework for mixing approaches, has quickly gained popularity (Timans et al., 2019). Figure 3.1 depicts the embedded design.

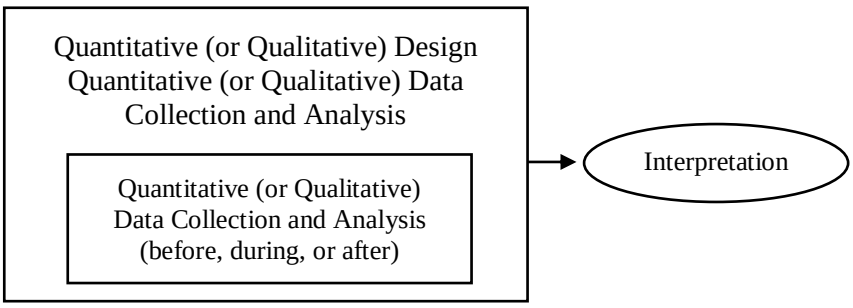


Figure 3.1 The Embedded Design
(Creswell, 2012)

Form of mixed-methods design allows the researcher to gather qualitative data while yet placing a strong emphasis on quantitative data overall. The function of qualitative data is legitimizing its usage in some sectors that are new to qualitative research (Creswell, 2012). In order to address difficult practical challenges, mixed methods research can complement other approaches, such as action research, by

providing a strong methodological foundation and developing an integrated strategy (Ivankova & Wingo, 2018). Figure 3.1 describes that there are three main activities in embedded design. Firstly, mixed methods approach prioritizes the primary form of data collection (often QUAN) and assigns secondary value to the supporting form (typically QUAL). Secondly, mixed techniques simultaneously or sequentially collect both the quantitative and qualitative data. During the study, both types of data are gathered roughly at the same time or in order. It is crucial to comprehend and specify the reasons behind collecting secondary data. Lastly, secondary form of data is used by mixed methods to supplement or provide extra sources of information that the primary source of data does not offer. The purpose of the augmentation is to collect data that usually answers a different question from the one posed by the primary source of data (Creswell, 2012). This embedded design can be broken down by following the phases below (Figure 3.2).

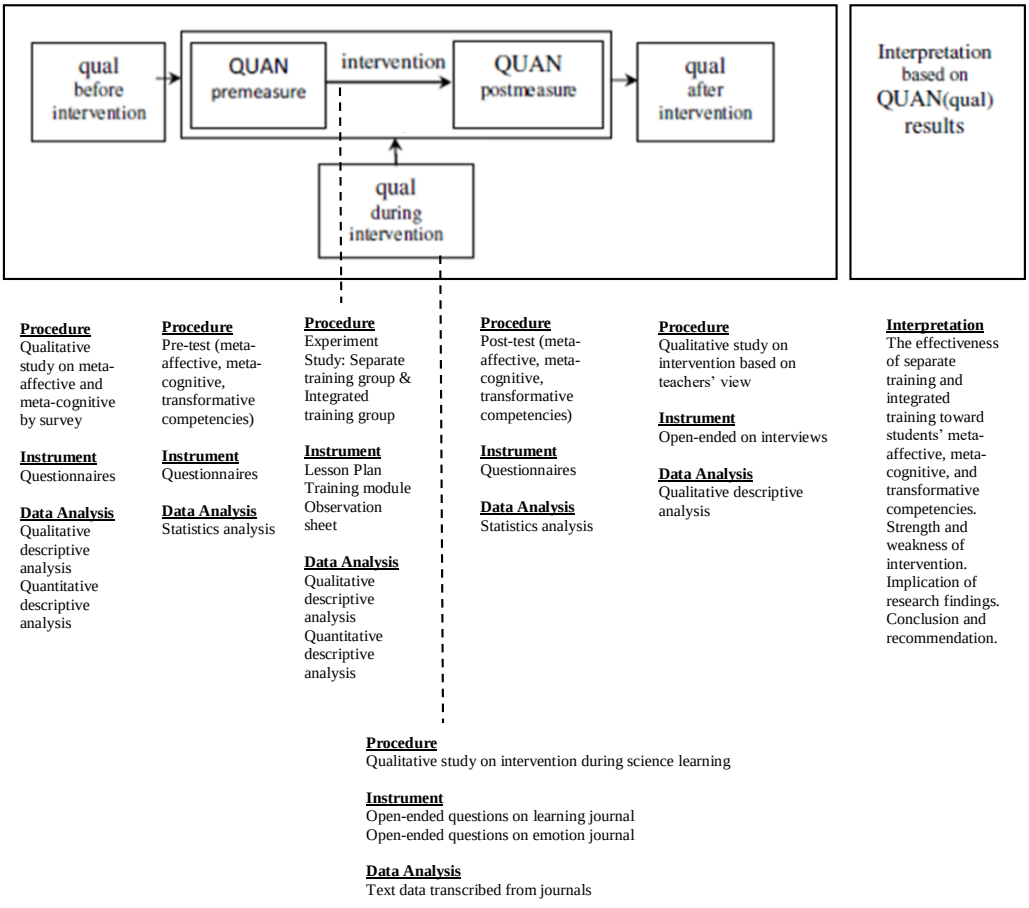


Figure 3.2 Research Phases of Embedded Design

Figure 3.2 describes the research phases of embedded design, where the first phase carried out in this research is "qual before intervention." A qualitative survey study on meta-affective and meta-cognitive issues was used. The instrument used is a questionnaire. Data analysis using qualitative descriptive analysis and quantitative descriptive analysis. This preliminary study consists of three activities, namely (1) a survey of science teachers regarding their experience in teaching meta-affective and meta-cognitive strategies via an online form, (2) a survey of junior, high school, vocational students, aspiring science teachers, and science teachers regarding meta-affective profiles, and (3) a survey of junior high school students whose schools have characteristics that are almost the same as the schools taking part in the research. The survey using the Meta-Affective Trait Scale (MATS) from prior studies and the Metacognitive Awareness Inventory (MAI) from prior studies, and also performing statistical correlation analysis. Furthermore, module construction on meta-affective and meta-cognitive-based training for teachers (integrated training) and students (separate training).

Before and after the intervention, students' meta-affective, meta-cognitive, and transformative skills are measured in the "QUAN premeasure" and "QUAN postmeasure" phases. They all employ a questionnaire that has been thoroughly evaluated, and statistical analyses demonstrate great validity and reliability. Prior to giving the students their tests, expert judgment was also used to get opinions and suggestions about the dimensions, sub-dimensions, and statements. During the "intervention" phase, research studies are being conducted in two research groups: the "Integrated Training" group and the "Separate Training" group. Each of the two groups was subjected to an experimental treatment. Throughout the science lessons, both received meta-affective and meta-cognitive training. There are 50 students from grades 7, 8, and 9 in each of these training groups to ensure that the science content is appropriate for their grade levels, namely 7^{th} grade students with the topic "forces", 8^{th} grade students with the topic "light and optics", and 9^{th} grade students with the topic "soils".

The intervention that distinguishes the two training groups is integrated training, in which the teacher works with students to apply meta-affective and meta-cognitive-based training while they are studying science. Students separately carry

out meta-affective and meta-cognitive training in separate settings while they are learning science. Researchers have trained science teachers who taught science in the integrated training group on meta-affective and meta-cognitive based training before these interventions. In addition, the researchers also provided training on meta-affective and meta-cognitive-based training to students who studied science in separate training groups. Furthermore, students in both integrated training and separate training write out learning journals and emotion journals during the "qual during intervention" phase. Students are free to record their thoughts and experiences in these journals because they are open-ended questions. The journals were delivered through an online platform, particularly Google Form, as the school was fully utilizing online learning at the time the research data was being collected.

Lastly, the researcher interviewed three teachers of science who had added meta-affective and meta-cognitive-based teaching material during the "qual after intervention" phase. In order to use meta-affective and meta-cognitive strategies while studying science, these teachers walk with students in the integrated training group. Following the collection of all data, both quantitative and qualitative, the "interpretation based on QUAN(qual) results" phase involves data processing and interpretation. Using IBM SPSS Statistics 25, quantitative information about students' meta-affective, meta-cognitive, and transformative skills was statistically examined. In order to determine whether to utilize parametric or non-parametric tests, the hypothesis had previously evaluated normality and homogeneity. The statistical test was a different test that served as an answer to the hypothesis. Additionally, qualitative data were gathered from video recordings of the learning process, teacher interviews, and student learning and emotion journals. Data triangulation was used to analyze the three data sets.

In all cases, one went to other internal indices that should provide convergent evidence since there was generally no external measure to compare the new finding against. This process was given the name triangulation, which has stuck ever since. Furthermore, their description of the procedure was accurate; they stated that a finding is validated by being subjected to "the onslaught of a series of imperfect measures". Triangulation is intended to demonstrate that several measures of a discovery concur with it or at the very least do not contradict it. The procedure

sounds more meticulous and complex than it actually is. It is simple to sit down and envision where one might look for or double-check sources of information that is corroborated, contrasted, and causally related. Additionally, it is fairly simple to gather information from various sources utilizing various techniques (including individuals in various jobs, deviant, and manistream informants), such as talking with people and observing routine life at the site (Miles & Huberman, 1984).

3.2 Participant

In total, 100 students took part in the study; 50 of them were in integrated training groups, and the remaining 50 received separate training (see Appendix 1 and Appendix 2). Each training group was composed of students from three distinct classes, namely grades 7, 8, and 9, in order to better represent the junior high school attendees. The original research plan selected one class from each of the three grades; however, data were finally gathered towards the conclusion of the study from the pre-test and post-test questionnaires for the three dependent variables that were measured. These variables namely meta-affective, meta-cognitive, and transformative competencies, from students who engaged in full learning during the research period. The selection of schools and classes in this study was based on the willingness of science teachers and students who wished to be involved. Table 3.1 describes the profile of the participants involved in this research.

Table 3.1
Profile of Participants in Integrated Training and Separate Training Groups

Group	School	Grade	Gender	Number	Total	Final Total
Integrated Training	School A	7	Male	5	12	50
			Female	7		
		8	Male	7	19	
			Female	12		
	School B	9	Male	11	19	
			Female	8		
Separate Training	School A	7	Male	10	22	50
			Female	12		
		8	Male	2	10	
			Female	8		
	School B	9	Male	9	18	
			Female	9		

The two schools involved in this study were different, but they shared a number of similarities, including being private junior high schools with addresses in Bandung, having the same science learning curriculum, having almost the same number of students in each class, incorporating English into learning activities, and having a range of academically qualified students in each class. Table 3.1 demonstrates that the proportion of students who participated in this research was unbalanced in terms of both gender and grade. One class from each grade in each school was chosen at the start of the research plan. Due to the beginning of the COVID-19 pandemic, there was a policy shift in each school's teaching methods throughout the execution of the research, and School A integrated two classes into a single online learning session. Additionally, School A and School B alternate using their respective school's learning management system for asynchronous learning at each meeting rather than fully implementing synchronous online learning.

3.3 Population and Sample

All students at two private junior high schools in Bandung city make up the research population, whereas all students at two classes make up the research sample. This sample was taken by non-random sampling methods using convenience sampling. A group of students who are easily available for study is known as a convenience sample. Convenience is the clear benefit of this sample strategy (Fraenkel et al., 2012). Convenience sampling is a quantitative sampling technique where the researcher chooses participants based on their availability and willingness to participate in the study (Creswell, 2012). Convenience sampling as one of non-probability sample. Convenience sampling is an opportunistic sample that draws from whoever is available at the time. Convenience sampling, also known as accidental sampling or opportunity sampling, entails selecting respondents who are nearby and continuing the procedure until the needed sample size is reached, or those who are conveniently available and reachable at the time (Cohen et al., 2007).

The principal's willingness to grant permission for this investigation at his school is the foundation of convenience in this study. Additionally, the readiness of

teachers to incorporate meta-affective and meta-cognitive strategies into lesson planning and use them in class to teach science. The most important factor, namely the students' willingness to participate in this study, was shown by their active engagement in science learning topics throughout the research period, willingness to complete learning and emotion journals, and willingness to complete questionnaires on meta-affective, meta-cognitive, and transformative competencies during the pre- and post-test. The teacher recalls students in the student group, and if there are any students who have not responded, the teacher personally reminds them via private chat in order to encourage more participation. The researcher was not directly involved with the students; they only met face-to-face during separate training prior to learning. This is to maintain the objectivity of the research. Figure 3.3 illustrates a profile of the population and sample in this research.

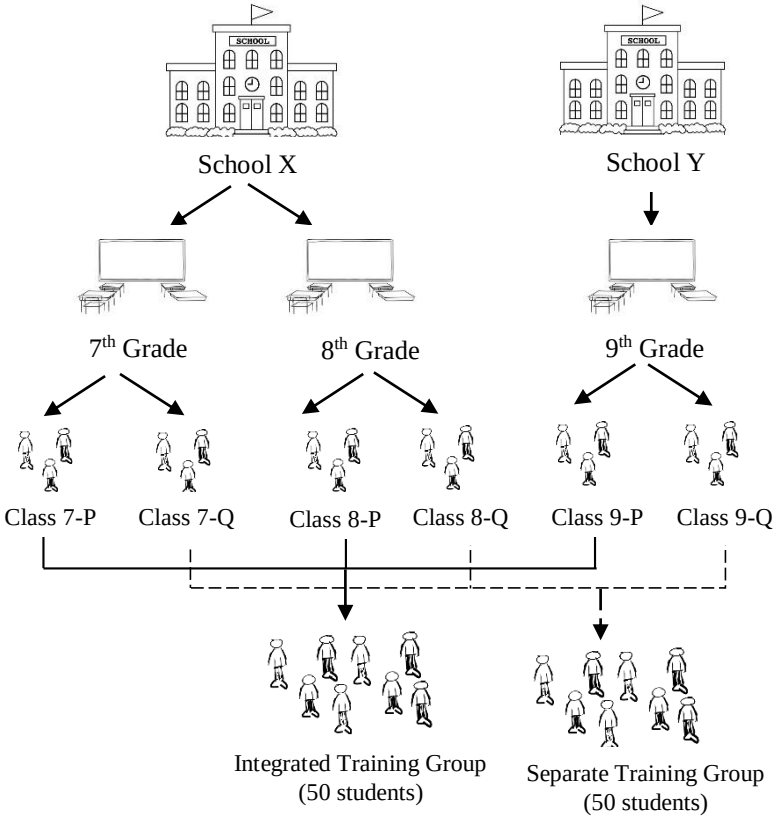


Figure 3.3 Profile of Population and Sample

3.4 Assumptions

This research is based on a number of ideas that are either assumed to be true or to be possible but whose veracity is unknown. Following are the presumptions made in this study:

1. Meta-affective and meta-cognitive-based training can encourage students to become aware of and regulate their strengths and weaknesses.
2. Meta-affective and meta-cognitive-based training can trigger students to know and regulate their reflection on course material.
3. Meta-affective and meta-cognitive-based training can guide students to discover how thoughts lead to actions and actions to feelings, which lead once again to thoughts.

3.5 Hypothesis

This study evaluates predictions of the outcomes of the research, or hypotheses. This is a provisional response to a hypothetical research topic. In order to determine the impact of meta-affective and meta-cognitive-based training on students' meta-affective, meta-cognitive, and transformative competences, three hypotheses are explored. The following hypotheses were investigated:

1. H_o: There is no difference in meta-affective in groups of students who receive separate and integrated meta-affective and meta-cognitive strategies training.
   H_1: There is difference in meta-affective in groups of students who receive separate and integrated meta-affective and meta-cognitive strategies training.
2. H_o: There is no difference in meta-cognitive in groups of students who receive separate and integrated meta-affective and meta-cognitive strategies training.
   H_1: There is difference in meta-cognitive in groups of students who receive separate and integrated meta-affective and meta-cognitive strategies training.

3. H_o: There is no difference in transformative competencies in groups of students who receive separate and integrated meta-affective and meta-cognitive strategies training.

   H_1: There is difference in transformative competencies in groups of students who receive separate and integrated meta-affective and meta-cognitive strategies training.

3.6 Research Instrument

A research instrument is required in order to address a research problem. In this research, both quantitative and qualitative data collection techniques and data types were used. Three different types of questionnaires were used as the research instrument in this study to measure the meta-affective, meta-cognitive, and transformative competencies of the students. Qualitative data were acquired coupled with quantitative data across the study period in the classroom. Journals, specifically emotion and learning journals, are used to compile qualitative data for analyses of students' meta-affective and meta-cognitive strategies during learning. Table 3.2 depicts methods of data collection and types of data.

Table 3.2
Methods of Data Collection and Types of Data

Research Variables	Quantitative Research		Qualitative Research	
	Instrument	Data	Instrument	Data
Meta-affective	Questionnaire	Numeric scores	Open-ended questions on emotion journal	Text data from students' transcribed answers
			Open-ended interviews	Text data from teachers' transcribed interviews
Meta-cognitive	Questionnaire	Numeric scores	Open-ended questions on learning journal	Text data from students' transcribed answers

Research Variables	Quantitative Research		Qualitative Research	
	Instrument	Data	Instrument	Data
			Open-ended interviews	Text data from teachers' transcribed interviews
Transformative Competencies	Questionnaire	Numeric scores	Open-ended questions on emotion and learning journals Open-ended interviews	Text data from students' transcribed answers Text data from teachers' transcribed interviews

3.6.1 Questionnaire of Meta-affective

The Meta-Affective Trait Scale (MATS) questionnaire, which was modified from earlier study, is the research instrument employed (Uzuntiryaki-Kondakci & Kirbulut, 2016). The original version of the MATS questionnaire consists of two dimensions, namely the Affective Awareness Dimension and the Affective Regulation Dimension, where 10 statements form the Affective Awareness Dimension and the other seven statements form the Affective Regulation Dimension. In addition, another characteristic is that there are six ranges of student response scales collected, namely: never (1), rarely (2), sometimes (3), often (4), mostly (5), and always (6). Appendix 3 describes the original questionnaire version of the Meta-Affective Trait Scale (MATS) based on dimensional distribution. Furthermore, Appendix 4 shows the original questionnaire version of the Meta-affective Trait Scale (MATS) based on answer scale description. Because the Meta-affective Trait Scale (MATS) has received high marks for validity and reliability in testing, this study modified it to measure students' meta-affective. The instrument does, however, go through a process of adaptation depending on the suggestions of expert judgment. Table 3.3 depicts the recapitulation of expert judgment suggestions.

Table 3.3
Recapitulation of Expert Judgment Suggestions on Meta-affective Questionnaire

No	Judgment Aspect	Suggestion
1	Dimension	a. The Affective Awareness Dimension and the Affective Regulation Dimension are the two dimensions that are kept. b. To enable measurements to be recognized for each sub-dimension, it is preferable to further specify each dimension into a number of sub-dimensions. c. The definition of each dimension and sub-dimension should be clearly stated in the specification table.
2	Content of Statement	a. The distribution based on the meta-affective dimension is preserved for the statements on the prior instrument. b. A focal statement on the activities students engage in while learning science is added to the statement.
3	Total of Statement	a. All 17 of the prior instrument's questions were used because they had strong measurement validity and reliability. b. Plus the amount of statements, with three statements measuring each sub-affective. This will make drawing conclusions at the study's conclusion easier. It will be challenging to draw any conclusions if both of the assertions indicate a contrast response if only one of them is representative. So three is the suggested number.
4	Range of Response Scale	This research can make use of the answer scale with six ranges.

A questionnaire to assess students' meta-affective was created using a variety of techniques, taking into consideration the recommendations from the expert judgment in Table 3.3. Deriving from the two previously developed dimensions, namely the Affective Awareness Dimension and Affective Regulation Dimension, first identify and examine the sub dimensions. There are six types of affective awareness about feelings, namely: pride and awareness, anger and boredom, happiness, enjoyment, sadness and disappointment, and nervousness. There are four types of regulation about affective, namely: panic and anxiety regulation, anger and

disappointment regulation, boredom and disinterest regulation, and enjoyment regulation. Secondly, to create a succinct definition for each dimension and sub-dimensionality, a literature research is then conducted. Thirdly, the number of statements that are more particular to students' experiences in class during science learning is increased, bringing the total number of statements for this study from the 17 original statements to 51. Table 3.4 depicts the specification of meta-affective questionnaire development.

Table 3.4
Specification of Meta-affective Questionnaire Development

Dimension	Statement Code								
Affective Awareness Dimension	MA-1	MA-2*	MA-3*	MA-4	MA-5*	MA-6*	MA-7	MA-8*	MA-9*
	MA-10	MA-11*	MA-12*	MA-13	MA-14*	MA-15*	MA-16	MA-17*	MA-18*
	MA-19	MA-20*	MA-21*	MA-22	MA-23*	MA-24*	MA-25	MA-26*	MA-27*
	MA-28	MA-29*	MA-30*						
Affective Regulation Dimension	MA-31	MA-32*	MA-33*	MA-34	MA-35*	MA-36*	MA-37	MA-38*	MA-39*
	MA-40	MA-41*	MA-42*	MA-43	MA-44*	MA-45*	MA-46	MA-47*	MA-48*
	MA-49	MA-50*	MA-51*						

** Additional statement of questionnaire development.*

A survey of junior high school students' science learning is used as the instrument testing. A total of 634 students participated in the study, 230 of whom were male and 404 of whom were female. There were 126 students in the ninth grade, 355 in the eighth grade, and 153 in the seventh grade, according to class. The participants were dispersed among 14 cities/districts in Indonesia's seven provinces, including West Java, North Sumatera, South Sumatera, West Sumatera, Special Capital District of Jakarta, Riau, and the Riau Islands (Rusyati et al., 2021g). Students in junior high school were examined on their knowledge of science using the meta-affective questionnaire. Google Form was used to distribute this survey online by using link https://forms.gle/pDC2Q24UCcGf9HLo7 and Appendix 5 describes the appearance of survey outline. Table 3.5 illustrates the distribution of school, city, and province on meta-affective and meta-cognitive questionnaire testing.

Table 3.5
Distribution of School, City, and Province on Meta-Affective and Meta-cognitive Questionnaire Testing

No	School	City/District	Province
1	SMP N 1 Jakarta	Central Jakarta	Special Capital District of Jakarta
2	SMP Cengkareng 1	West Jakarta	Special Capital District of Jakarta
3	SMP Methodist 12 Medan	Medan	North Sumatera
4	SMP N 1 Abab	Pali	South Sumatera
5	SMP N 14 Palembang	Palembang	South Sumatera
6	SMP Negeri 4 Batang Anai	Padang Pariaman	West Sumatera
7	SMP N 3 Sitiung	Dharmasraya	West Sumatera
8	SMP Masmur Pekanbaru	Pekanbaru	Riau
9	SMP Islam Asshofa Pekanbaru	Pekanbaru	Riau
10	SMP Kristen BASIC	Batam	Riau Islands
11	SMP N 2 Kadudampit	Sukabumi	West Java
12	SMP Negeri 2 Jatiwangi	Majalengka	West Java
13	SMP Yos Sudarso Garut	Garut	West Java
14	SMP N 1 Terisi	Indramayu	West Java
15	SMP Nurul Halim Widasari	Indramayu	West Java
16	SMP Negeri Satu Atap 1 Lelea	Indramayu	West Java
17	SMP Negeri 15 Bandung	Bandung	West Java

The principal's approval, the openness of science teachers and students to participate in the meta-affective questionnaire testing, and the selection of the schools and classes indicated in Table 3.5 all played a role in the process. A summary of responses is available at the link https://bit.ly/InstrumentTesting (see Appendix 6). The student responses were examined using the Winsteps Rasch Model to ascertain the person reliability and item reliability index (Bond & Fox, 2015; Fischer & Molenaar, 2012). Appendix 7 describes the Cronbach's Alpha as the reliability index of meta-affective questionnaire based on IBM SPSS Statistics 25. Furthermore, Appendix 8 explains the person reliability and item reliability index of meta-affective questionnaire based on Winsteps Rasch model. Table 3.6 depicts the reliability index's findings based on the Winsteps Rasch Model and IBM SPSS Statistics 25.

Table 3.6
Reliability Index of Meta-affective Questionnaire by using Winsteps Rasch Model and IBM SPSS Statistics 25

Aspect	N of students	N of items	Person Reliability	Item Reliability	Cronbach's Alpha	Category
Meta-affective	634	51	0.92	0.99	0.93	Acceptable
a. Awareness Dimension	634	30	0.85	1.00	0.87	Acceptable
b. Regulation Dimension	634	21	0.90	0.95	0.93	Acceptable

Based on Table 3.6, it is determined that the meta-affective questionnaire created for this research is suitable and can be used for other research both based on the person and item reliability index (Bond & Fox, 2015; Fischer & Molenaar, 2012). In addition to computing the reliability index with the Winsteps Rasch Model, the data from the test results were also computed with IBM SPSS Statistics 25 to see Cronbach's Alpha, which displays the reliability index (Myers & Well, 2003; Yockey, 2016). The meta-affective questionnaire created for this study has a high Cronbach's Alpha score, allowing one questionnaire package to be used for other research. Students' meta-affective tendencies related to emotions when they are studying for their classes are measured by the meta-affective questionnaire. Relationships between learning techniques, self-efficacy, and meta-affective qualities that are both significant and favorable (Uzuntiryaki-Kondakci & Kirbulut, 2016). All of the statements on this questionnaire passed the index validity test, which was also conducted, and the findings were positive (Rusyati et al., 2021g). Table 3.7 presents the results from the development of the meta-affective questionnaire.

Table 3.7
The Final Version of Meta-affective Questionnaire Development

Dimension	Type	Code	Item
Affective Awareness	Pride and awareness	MA-1	Feel proud of his/her self when is successful.
		MA-2*	Feel proud of his/her self when completing the task.
		MA-3*	Feel proud of his/her self when answering the question from teacher.
		MA-28	Aware of which topics is interested in.
		MA-29*	Aware how strategy to complete the task.
		MA-30*	Aware how to work in group.
	Anger and boredom	MA-4	Feel angry with his/her self when is not understand a topic.
		MA-5*	Feel hopeless with his/her self when is not understand a topic.

Dimension	Type	Code	Item
		MA-6*	Feel not spirit with his/her self when is not understand a topic.
		MA-16	Feel bored while studying.
		MA-17*	Feel bored while teacher explains the lesson topic.
		MA-18*	Feel bored while discussion process.
	Happiness	MA -8*	Feel happy when understand a topic.
		MA-9*	Feel excited when understand a topic.
		MA-19	Feel happy when understand a topic.
		MA-20*	Feel happy when finish the presentation.
		MA-21*	Feel happy when can convey an opinion or argument.
	Enjoyment	MA-7	Feel relaxed when understand a topic.
		MA-25	Enjoy his/her self while studying.
		MA-26*	Enjoy his/her self while completing the task.
		MA-27*	Enjoy his/her self while completing the worksheet in group.
	Sadness and disappointment	MA-13	Feel disappointed when cannot answer a question.
		MA-14*	Feel disappointed when the test minimum score is not achieved.
		MA-15*	Fell disappointed when He/She has studied but the grades is not satisfactory.
		MA-22	Feel sad when is not understand a topic.
		MA-23*	Feel sad when did not complete the task on time.
		MA-24*	Feel sad when not fully present in one topic learning.
	Nervousness	MA-10	Feel nervous during exams.
		MA-11*	Feel nervous during presentation session.
		MA-12*	Feel nervous during asked by the teacher.
Affective Regulation	Panic and anxiety regulation	MA-31	Feel panic while studying and try to control that feeling.
		MA-32*	Feel panic while do test and try to control that feeling.
		MA-33*	Fell panic while presentation and try to control that feeling.
		MA-40	Feel anxious during exams and try to control that feeling.
		MA-41*	Feel anxious during presentation and try to control that feeling.
		MA-42*	Feel anxious during completing worksheet and try to control that feeling.
	Anger and disappointment regulation	MA-34	Feel disappointed when is not successful and try to control that feeling.
		MA-35*	Feel disappointed when the assignment is not appreciated by the teacher and try to control that feeling.
		MA-36*	Feel disappointed when your opinion is not supported by others and try to control that feeling.
		MA-37	Feel angry when is not successful and try to control that feeling.

Dimension	Type	Code	Item
		MA-38*	Feel angry when not understand about topic that not interested in and try to control that feeling.
		MA-39*	Feel angry when should be remember many difficult key concepts and try to control that feeling.
	Boredom and disinterest regulation	MA-43	When have to learn a topic that is not interested in, try to find ways to make it interesting.
		MA-44*	When have to learn a topic that is not interested in, try to construct summary to make it interesting.
		MA-45*	When have to learn a topic that is not interested in, try to discuss with friend to make it interesting.
		MA-46	If get bored while studying, seek ways to get rid of that feeling.
		MA-47*	If get bored while studying, discuss with friend to get rid of that feeling.
		MA-48*	If get bored while studying, seek learning video to get rid of that feeling.
	Enjoyment regulation	MA-49	While learning a topic, seek ways to enjoy it.
		MA-50*	While learning a topic, go to outdoor to enjoy it.
		MA-51*	While learning a topic, play the music/video to enjoy it.

**Additional statement of questionnaire development.*

3.6.2 Questionnaire of Meta-cognitive

This study made use of the Metacognitive Awareness Inventory (MAI) questionnaire, which was created as a result of earlier studies (Harrison & Vallin, 2018). The two metacognitive dimensions are Knowledge of Cognition Dimension and Regulation of Cognition Dimension. Understanding mental processes, particularly declarative memory understanding, is knowledge of cognition. Declarative, procedural, and conditional knowledge are all covered by the knowledge dimension's components (Harrison & Vallin, 2018). A person's constant evaluation of what is understood and what is still unknown constitutes cognition regulation. Planning, information management strategies, monitoring, debugging strategies, and evaluation are all included in the regulation dimension (Harrison & Vallin, 2018). Appendix 9 describes the original questionnaire version of the Metacognitive Awareness Inventory (MAI) based on dimensional distribution. Furthermore, Appendix 10 shows the original questionnaire version of the Metacognitive Awareness Inventory (MAI) based on answer scale description.

Because the Metacognitive Awareness Inventory (MAI) has received high marks for validity and reliability in testing, this study modified it to measure students' meta-cognitive. The instrument does, however, go through a process of adaptation depending on the suggestions of expert judgment. Table 3.8 depicts the recapitulation of expert judgment suggestions.

Table 3.8
Recapitulation of Expert Judgment Suggestions on Meta-cognitive Questionnaire

No	Judgment Aspect	Suggestion
1	Dimension	a. The two dimensions that are retained are the Knowledge of Cognition Dimension and the Regulation of Cognition Dimension. Every sub-dimension is reusable for this research. b. The specification table should have a clear definition for each dimension and sub-dimension.
2	Content of Statement	a. For the statements on the prior instrument, the distribution based on the meta-cognitive dimension is maintained. b. The statement is supplemented with a focal point on the activities students participate in while learning science.
3	Total of Statement	a. The 19 questions from the previous instrument were all used because of their high measurement validity and reliability. b. Additionally, three statements were used to measure each sub-dimension. Drawing conclusions at the end of the investigation will be simpler as a result. If only one of the assertions is representative, it will be difficult to draw any inferences if both point to a different reaction. So the suggested number is three.
4	Range of Response Scale	The answer options should be reorganized into six response scales in order to be more objective and discourage students from selecting the middle option.

A questionnaire to assess students' meta-cognitive was created using a variety of techniques, taking into consideration the recommendations from the expert judgment in Table 3.8. Deriving from the two previously developed dimensions,

namely the Knowledge of Cognition Dimension and Regulation of Cognition Dimension, first identify and examine the dimensions. There are three sub-dimensions of Knowledge of Cognition dimension, namely Declarative Knowledge (DK), Procedural Knowledge (PK), and Conditional Knowledge (CK). There are five sub-dimensions of Regulation of Cognition dimension, namely Planning (P), Information Management Strategies (IMS), Monitoring (M), Evaluation (E), and Debugging Strategies (DS). Secondly, expand the five scale responses into six scale responses. Thirdly, the number of statements that are more particular to students' experiences in class during science learning is increased, bringing the total number of statements for this study from the 19 original statements to 32. Table 3.9 describes the specification of meta-cognitive questionnaire development.

Table 3.9
Specification of Meta-cognitive Questionnaire Development

Dimension	Sub-Dimension	Statement Code			
Knowledge of Cognition Dimension	Declarative knowledge (DK)	MC-1	MC-2	MC-3	MC-4
	Procedural Knowledge (PK)	MC-5	MC-6	MC-7*	MC-8*
	Conditional Knowledge (CK)	MC-9	MC-10	MC-11*	MC-12*
Regulation of Cognition Dimension	Planning (P)	MC-13	MC-14	MA-15*	MA-16*
	Information Management Strategies (IMS)	MC-17	MC-18	MC-19	MC-20*
	Monitoring (M)	MC-21	MC-22*	MC-23*	MC-24*
	Evaluation (E)	MC-25	MC-26	MC-27*	MC-28*
	Debugging Strategies (DS)	MC-29	MC-30	MC-31	MC-32*

** Additional statement of questionnaire development.*

Surveying junior high school students' knowledge of science is the instrument testing used. The 230 male students and 404 female students out of a total of 634 students participated in this study. According to class, there were 355 students in the 7th grade, 153 in the 8th grade, and 126 in the 9th grade. The Indonesian provinces of Riau, the Riau Islands, North Sumatera, South Sumatera, West Sumatera, Special Capital District of Jakarta, and West Java each had a participant from one of the 14 cities or districts that made up the seven provinces (Rusyati et al., 2022d). Students

in junior high school were examined on their knowledge of science using the meta-cognitive questionnaire. Google Form was used to distribute this survey online by using link https://forms.gle/pDC2Q24UCcGf9HLo7 and Appendix 5 describes the appearance of survey outline. The distribution of school, city, and province on meta-cognitive questionnaire testing is same with the meta-affective questionnaire testing (see Table 3.4).

A summary of responses of meta-cognitive questionnaire is available at the link https://bit.ly/InstrumentTesting (see Appendix 11). The student responses were examined using the Winsteps Rasch Model to ascertain the person reliability and item reliability index (Bond & Fox, 2015; Fischer & Molenaar, 2012). Appendix 12 describes the Cronbach's Alpha as the reliability index of meta-cognitive questionnaire based on IBM SPSS Statistics 25. Furthermore, Appendix 13 explains the person reliability and item reliability index of meta-cognitive questionnaire based on Winsteps Rasch model. Table 3.10 depicts the reliability index's findings based on the Winsteps Rasch Model and IBM SPSS Statistics 25.

Table 3.10
Reliability Index of Meta-cognitive Questionnaire by using Winsteps Rasch Model and IBM SPSS Statistics 25

Aspect	N of students	N of items	Person Reliability	Item Reliability	Cronbach's Alpha	Category
Meta-cognitive	634	32	0.94	0.97	0.96	Acceptable
a. Knowledge of Cognition	634	12	0.87	0.97	0.92	Acceptable
b. Regulation of Cognition	634	20	0.91	0.97	0.95	Acceptable

Based on Table 3.10, it is determined that the meta-cognitive questionnaire created for this research is suitable and can be used for other research both based on the person and item reliability index (Bond & Fox, 2015; Fischer & Molenaar, 2012). In addition to computing the reliability index with the Winsteps Rasch Model, the data from the test results were also computed with IBM SPSS Statistics 25 to see Cronbach's Alpha, which displays the reliability index (Myers & Well, 2003; Yockey, 2016). The meta-cognitive questionnaire created for this study has a high Cronbach's Alpha score, allowing one questionnaire package to be used for other research. All of the statements on this questionnaire passed the index validity test, which was also conducted, and the findings were positive (Rusyati et al.,

2022d). Table 3.11 presents the results from the development of the meta-cognitive questionnaire.

Table 3.11
The Final Version of Meta-cognitive Questionnaire Development

Dimension	Sub-Dimension	Code	Item
Knowledge of cognition	Declarative knowledge (DK)	MC-1	I know what kind of information is most important to learn.
		MC-2	I know what the teacher expects me to learn.
		MC-3	I have control over how well I learn.
		MC-4	I am a good judge of how well I understand something.
	Procedural Knowledge (PK)	MC-5	I am aware of what strategies I use when I study.
		MC-6	I use the helpful learning strategies automatically.
		MC-7*	I am aware of the type of strategy suitable for learning a particular concept.
		MC-8*	I can practice the learning strategies as I plan.
	Conditional Knowledge (CK)	MC-9	I can motivate myself to learn when I need to.
		MC-10	I know when each strategy I use will be most effective.
		MC-11*	I can come up with another strategy if the strategy currently being used is less effective.
		MC-12*	I can convince myself that I am able to understand the learning material.
Regulation of cognition	Planning (P)	MC-13	I think about what I really need to learn before I begin a task.
		MC-14	I set specific goals before I begin a task.
		MC-15*	I realized the benefits before starting to study.
		MC-16*	I make details of the activities before starting to study.
	Information Management Strategies (IMS)	MC-17	I try to translate new information into my own words.
		MC-18	I use the organizational structure of the text to help me learn.
		MC-19	I ask myself if what I'm reading is related to what I already know.
		MC-20*	I make a concept map / mind map or something else to help me learn.
	Monitoring (M)	MC-21	I periodically review to help me understand important relationships.
		MC-22*	I re-read the material that had been studied.
		MC-23*	I discuss with friends to strengthen understanding of the material being studied.
		MC-24*	I ask other people to test me about understanding the material that has been studied.
	Evaluation (E)	MC-25	I summarize what I've learned after I finish.
		MC-26	I ask myself if I learned as much as I could have once I finish a task.

Dimension	Sub-Dimension	Code	Item
		MC-27*	I passed the outline of the material to others to clarify whether my understanding was correct or not.
		MC-28*	I add information from other sources to confirm that my understanding is correct.
	Debugging Strategies (DS)	MC-29	I change strategies when I fail to understand.
		MC-30	I re-evaluate my assumptions when I get confused.
		MC-31	I stop and go back over new information that is not clear.
		MC-32*	I recheck my own understanding if it is different from other people's understanding.

**Additional statement of questionnaire development.*

3.6.3 Questionnaire of Transformative Competencies

The questionnaire instrument consist of 39 statements with five Likert scales (1 = not at all typical of me, 2 = not very typical of me, 3 = somewhat typical of me, 4 = fairly typical of me, and 5 = very typical of me). This questionnaire was developed based on three Transformative Competencies (TC), namely (1) Creating New Value, (2) Reconciling Tensions and Dilemmas, and (3) Taking Responsibility developed by the Directorate for Education and Skills-OECD (OECD Directorate for Education and Skills, 2018). The competency of "Creating New Value" consists of four indicators, namely Adaptability, Creativity, Curiosity, and Open-mindedness. The competency of "Reconciling Tensions and Dilemmas" consists of four indicators, namely Integrated Way, Inter-relations, Logics and Positions, and Perspectives. The competency of "Taking Responsibility" consists of five indicators, namely Think and Work, Consequences, Evaluation, Accountability, and Reflection. Appendix 14 describes the official source of Transformative Competencies as part of the Future of Education and Skills 2030. This questionnaire's formulation also relied on expert judgment. Table 3.12 depicts the recapitulation of expert judgment suggestions.

Table 3.12
Recapitulation of Expert Judgment Suggestions on Transformative Competencies Questionnaire

No	Judgment Aspect	Suggestion
1	Dimension	a. Three competencies follow the OECD framework: creating new value, reconciling tensions and dilemmas, and taking responsibility. b. It is preferable to further subdivide each dimension into a number of sub-dimensions in order to enable measurements to be recognized for each sub-dimension. c. The specification table should have a clear definition for each dimension and sub-dimension.
2	Content of Statement	The statement is supplemented with a focal point on the activities students participate in while learning science.
3	Total of Statement	Three statements should be used to measure each sub-affective when constructing the number of statements. Drawing conclusions at the end of the investigation will be simpler as a result. If only one of the assertions is representative, it will be difficult to draw any inferences if both point to a different reaction. So the suggested number is three.
4	Range of Response Scale	The five-range answer scale can be used for this study.

In total, 445 students from 10 schools representing the Indonesian provinces of Special Capital Region of Jakarta, North Sumatra, South Sumatra, Riau, and West Java took part in the study. Participants included 271 female students and 174 male students, representing grades 7 through 9, respectively. There were 222 students in 7^{th} grade, 91 in 8^{th} grade, and 132 in 9^{th} grade. Each participant is using the Indonesian Curriculum, specifically Curriculum 2013, to learn science, which is the same for everyone. The Google Form application was used to disseminate the questionnaire instrument online via link https://forms.gle/RkTWJdxYC2HkZvug7 and Appendix 15 describes the appearance of survey outline. Table 3.13 describes

the distribution of school, city, and province on transformative competencies questionnaire testing.

Table 3.13
Distribution of School, City, and Province on Transformative Competencies Questionnaire Testing

No	School	City/District	Province	Participant
1	SMP Cengkareng 1	West Jakarta	Special Capital District of Jakarta	110
2	SMP Methodist 12 Medan	Medan	North Sumatera	23
3	SMP N 1 Abab	Pali	South Sumatera	4
4	SMP N 14 Palembang	Palembang	South Sumatera	101
5	SMP Masmur Pekanbaru	Pekanbaru	Riau	3
6	SMP Islam Asshofa Pekanbaru	Pekanbaru	Riau	8
7	SMP N 2 Kadudampit	Sukabumi	West Java	52
8	SMP Negeri 2 Jatiwangi	Majalengka	West Java	79
9	SMP Yos Sudarso Garut	Garut	West Java	30
10	SMP N 1 Terisi	Indramayu	West Java	35

The choice of the schools and classes shown in Table 3.13, the principal's consent, and the willingness of science teachers and students to take part in the transformative competencies questionnaire testing all had an impact on the outcome. A summary of responses is available in Appendix 16 at the link https://bit.ly/InstrumentTesting. The student responses were examined using the Winsteps Rasch Model to ascertain the person reliability and item reliability index (Bond & Fox, 2015; Fischer & Molenaar, 2012). Appendix 17 describes the Cronbach's Alpha as the reliability index of transformative competencies questionnaire based on IBM SPSS Statistics 25. Furthermore, Appendix 18 explains the person reliability and item reliability index of transformative competencies questionnaire based on Winsteps Rasch model. Table 3.14 depicts the reliability index's findings based on the Winsteps Rasch Model and IBM SPSS Statistics 25.

Table 3.14
Reliability Index of Transformative Competencies Questionnaire by using Winsteps Rasch Model and IBM SPSS Statistics 25

Transformative Competencies	N of students	N of items	Person Reliability	Item Reliability	Cronbach's Alpha	Category
Skills 2030 (all competencies)	445	39	0.94	0.97	0.96	Acceptable
a. Creating new value	445	12	0.82	0.98	0.86	Acceptable
b. Reconciling tensions and dilemmas	445	12	0.85	0.95	0.89	Acceptable
c. Taking responsibility	445	15	0.87	0.87	0.92	Acceptable

Based on Table 3.14, it is determined that the transformative competencies questionnaire created for this research is suitable and can be used for other research both based on the person and item reliability index (Bond & Fox, 2015; Fischer & Molenaar, 2012). In addition to computing the reliability index with the Winsteps Rasch Model, the data from the test results were also computed with IBM SPSS Statistics 25 to see Cronbach's Alpha, which displays the reliability index (Myers & Well, 2003; Yockey, 2016). The transformative competencies questionnaire created for this study has a high Cronbach's Alpha score, allowing one questionnaire package to be used for other research. All of the statements on this questionnaire passed the index validity test, which was also conducted, and the findings were positive (Rusyati et al., 2021c). Table 3.15 presents the results from the development of the transformative competencies questionnaire.

Table 3.15
The Final Version of Transformative Competencies Questionnaire Development

Competency	Indicator	Code	Item
Creating New Value	Adaptability (An ability or willingness to change in order to suit different conditions)	TC-1	I can still present ideas and solutions even in different groups.
		TC-2	I can follow to the variety of learning methods given by the teacher.
		TC-3	I am trying to change the way I learn when studying different science topics.
	Creativity (The ability to produce original and unusual ideas, or to make something new or imaginative)	TC-4	I can offer new solutions when there are problems while studying science.
		TC-5	I can present ideas or solutions that others have not thought of.
		TC-6	I can give examples or explanations that develop from imagination.

Competency	Indicator	Code	Item
	Curiosity (A strong desire to know or learn something)	TC-7	If there is new information, I am very challenged to find the answer.
		TC-8	If there is knowledge that is different from what I already have, I will ask a teacher or friend until I understand..
		TC-9	If I don't understand the teacher's explanation, I will look for other sources that can help me understand.
	Open-mindedness (The quality of being willing to consider ideas and opinions that are new or different)	TC-10	I can accept if there are new knowledge while studying science.
		TC-11	I use the knowledge that I have to understand new knowledge while studying science.
		TC-12	If there is a new knowledge that is a little different from the knowledge I have, I will be open-minded to try to understand it.
Reconciling Tensions and Dilemmas	Integrated way (Ability to think with two or more things combined in order to avoids premature conclusions)	TC-13	When I studied science, I thought in various ways to understand science.
		TC-14	When studying science, I do activities in various ways to understand science.
		TC-15	If I get new information in class, I will not immediately conclude but will look for other sources to corroborate the conclusion.
	Inter-relations (Ability to take into account the interconnections and interrelations between contradictory or incompatible ideas)	TC-16	I thought of understanding science by considering the relationship between opposing ideas.
		TC-17	I undertake activities to understand science by considering the relationship between opposing ideas.
		TC-18	If there are ideas that don't match, I try to find connections with other ideas while studying science.
	Logics and Positions (Ability to learn to think and act from both logics and positions)	TC-19	When studying science, I used logic to understand science.
		TC-20	When studying science, I use the point of view of a certain position to understand science.
		TC-21	I understand science easier, if I use logic that I make myself.
	Perspectives (Ability to learn to think and act from both short- and long-term perspectives)	TC-22	When studying science, I tried to think from a short-term and long-term perspective/perception.
		TC-23	When studying science, I tried to act from both short and long term perspectives/perceptions.
		TC-24	While studying science, I was able to sort out short-term and long-term viewpoints/perceptions.
Taking Responsibility	Think and Work (Ability to think for themselves and work with others)	TC-25	I can think for myself and communicate to friends while studying science.
		TC-26	I can work with friends while studying science.
		TC-27	I complete my work according to the division of labor in the group while studying science.

Competency	Indicator	Code	Item
	Consequences (Ability to consider the future consequences of one's actions)	TC-28	While studying science, I considered the future consequences of my actions.
		TC-29	While studying science, I considered future consequences of the thoughts I conveyed.
		TC-30	During studying science, I believed that there were effects (consequences) in the future, so I would be careful in thinking and acting.
	Evaluation (Ability to evaluate risk and reward)	TC-31	While studying science, I was able to evaluate which thoughts or actions would pose a risk.
		TC-32	While studying science, I was able to evaluate which thoughts or actions would bring goodness.
		TC-33	During my study of science, I was able to determine the thoughts or actions that produced more benefits than risks.
	Accountability (Ability to accept accountability for the products of one's work)	TC-34	While studying science, I can be accountable for the thoughts that I convey.
		TC-35	During my study of science, I can be held accountable for the actions I take.
		TC-36	When studying science in groups, I can accept a friend's job as a form of responsibility for that person.
	Reflection (Ability to reflect upon and evaluate his or her actions)	TC-37	During my study of science, I reflected on whether the actions I had taken were right or still wrong.
		TC-38	During my study of science, I reflected on whether the actions I took were in accordance with my personal and group study goals.
		TC-39	During my study of science, I reevaluated actions based on experiences that had already occurred.

3.7 Research Procedure

This study consisted of three stages: the preparation stage, the implementation stage, and the completion stage. The activities carried out in each of these stages are as follows:

1. Preparation Stage
   a. Analysis of science syllabus of Curriculum 2013 for JHS level.

      According to the anticipated research period, this stage defines the science subjects being taught in junior high schools in the present semester. This research is concerned with current science topic rather than a specific science topic. The initial research plan, meta-affective and meta-cognitive based training was carried out for one full semester, but for several reasons only one

topic was taken in grades 7, 8 and 9. These were the reasons that the COVID-19 pandemic caused the school to modify how learning was implemented, moving from offline to online learning. Another issue is that because online learning is new, schools management, teachers, students, and online learning infrastructure are still getting up to speed. Another finding is that learning is not entirely synchronous when taking part in online meetings; rather, asynchronous learning occurs occasionally when using a learning management system or social media. The data were taken from 7^{th} grade students with the topic "Forces", 8^{th} grade with the topic "Light and Optic", and 9^{th} grade with the topic "Soils".

b. Analysis of literature about students' meta-affective.

   In this section, recent material from renowned national and international journals published in the last ten years is analyzed. Additionally, a synthesis is done to discover meta-affective learning patterns, including dimensions, sub-dimensions, how to teach them, advantages, and the current circumstances.

c. Analysis of literature about students' meta-cognitive.

   The last ten years' worth of literature from respectable national and international periodicals are analyzed in this part. In order to identify patterns of meta-cognitive in learning, including dimensions, sub-dimensions, how to train them in learning, benefits, and the current conditions, a synthesis is also performed.

d. Analysis of literature about students' transformative competencies.

   The last ten years' worth of reliable international and national periodicals' publications are analyzed in this part. A synthesis is also performed in order to identify patterns of transformative competencies learning, including dimensions, sub-dimensions, how to teach them, advantages, and the current circumstances.

e. The preliminary study about students' meta-affective and meta-cognitive.

   This preliminary study consists of three activities:

   1) A survey of science teachers regarding their experience in teaching meta-affective and meta-cognitive strategies via an online form with a link

https://forms.gle/soK2KcNEypRxwiREA. Appendix 19 illustrates an online teacher survey on meta-affective and meta-cognitive-based teaching experiences. A total of 267 teachers took part in the online survey, 216 of whom were female and 51 of whom were male. The distribution of participants' residences was 95.5% from Western Indonesia, 3.0% from Central Indonesia, and 1.5% from Eastern Indonesia. Appendix 20 describes the results of teacher's experience with meta-affective and meta-cognitive-based teaching. The activities "Ask students to keep a personal emotion journal and discuss it" and "Clarify students' personal emotional journal" are the least frequently done by the teacher while learning takes place in class.

2) A survey of junior, high school, vocational students, aspiring science teachers, and science teachers regarding meta-affective profiles. Both were quantified using the MATS and MAI from earlier investigations. Appendix 21 depicts the recapitulation of respondents' responses on an online survey for meta-affective (MATS) and meta-cognitive (MAI) experience and summary in link https://bit.ly/PreliminaryStudyMATS-MAI. A total of 923 participants took part in the online survey with distribution 205 of junior high school students, 354 of senior high school students, 187 of vocational high school students, 101 of prospective teachers, and 76 of science teachers.
3) A survey of junior high school students whose schools have characteristics that are almost the same as the schools taking part in the research, using the Meta-Affective Trait Scale (MATS) from prior studies and the Metacognitive Awareness Inventory (MAI) from prior studies, and also performing statistical correlation analysis. There is a significant correlation between the meta-affective and meta-cognitive data that were gathered for this correlation analysis. Appendix 22 illustrates the correlation testing results between students' meta-affective and meta-cognitive in junior high school.

f. Research instrument making.

Three instruments were employed in this study to assess students' meta-affective, meta-cognitive, and transformative skills. All three instruments were questionnaires. The previously investigated questionnaires were used to create the meta-affective and meta-cognitive (see Appendix 3 and Appendix 4 for Meta-affective Trait Scale; Appendix 9 and Appendix 10 for Metacognitive Awareness Inventory). Moreover, Appendix 23 explains the transformative competencies questionnaire prior to revision. This questionnaire was originally based on research following the official source (see Appendix 14).

g. Research instrument validation by expert.

Experts suggested that the three questionnaires to assess meta-affective, meta-cognitive, and transformative competencies be taken into consideration. Before conducting further student testing, the instrument was revised based on the expert's recommendations (see Table 3.3, Table 3.8, and Table 3.12).

h. Research instrument testing.

After expert evaluation and recommendations, the instrument was improved, and junior high school students were tested. The study involved 634 students in total, 230 of whom were male and 404 of whom were female. According to class, there were 153 students in the seventh grade, 355 in the eighth grade, and 126 in the ninth grade. In 14 cities/districts across Indonesia's seven provinces, the subjects underwent meta-affective and meta-cognitive questionnaire testing (see Table 3.5). Furthermore, the survey involved a total of 445 students from 10 different schools, who represented the Indonesian provinces. There are 271 female students and 174 male students, correspondingly representing grades 7 through 9, participated. In seventh grade, there were 222 students, 91 in eighth grade, and 132 in ninth grade. This survey for transformative competencies questionnaire testing (see Table 3.13).

i. Research instrument revision.

Student-tested questionnaires that were later statistically analyzed and revised in light of the findings. The statistical analysis can be shown at Table 3.6, Table 3.10, and Table 3.14.

j. Module construction on meta-affective and meta-cognitive based training.

1) Module for teachers.

Using this module, researchers can train teachers who are involved in performing research on meta-affective and meta-cognitive topics. Teachers can utilize the meta-affective and meta-cognitive strategies in this module to support their students as they learn science in integrated groups. Figure 3.4 illustrates a module on meta-affective and meta-cognitive-based training for teachers, and the full version can be found at Appendix 24.

Figure 3.4
Module on Meta-affective and Meta-cognitive-based Training for Teachers

2) Module for students.

This module is used to implement meta-affective and meta-cognitive based training provided by researchers to students who are engaged in research. Students can employ the meta-affective and meta-cognitive

strategies found in this module in separate groups and then put them into practice while learning science. Figure 3.5 depicts a module on meta-affective and meta-cognitive-based training for students, and the full version can be found at Appendix 25.

Figure 3.5
Module on Meta-affective and Meta-cognitive-based Training for Students

Both have undergone an expert assessment with recommendations focusing on: (1) the teacher module should contain a clear schedule for training; (2) the teacher module should contain what activities are carried out during training; (3) the teacher module should contain signs for implementing meta-affective and meta-cognitive-based training in science learning; and (4) modules for students and teachers should contain concise explanations and indicators about meta-affective and meta-cognitive; and (5) modules for students that focus more on how students' strategies implement meta-affective and meta-cognitive in learning science.

k. Research authorization to the principal

There are three permissions, namely those for preliminary study, testing of research instruments, and carrying out actual research. Letters of

authorization for preliminary study to school principals are included in Appendix 26. Letters granting authorization to test research instruments are included in Appendix 27. Moreover, letters requesting permission to do actual research are included in Appendix 28.

2. Implementation Stage

   a. Training for teachers who teach science in integrated group.

      The teacher supports meta-affective and meta-cognitive strategies in the group of students participating in the integrated training during science lessons. As a result, the researchers gave the study's participating instructors training in meta-affective and meta-cognitive-based teaching. Lesson plans remain constant and are created by the teacher depending on the particulars of each school. Incorporating each of the 10 meta-affective and meta-cognitive strategies into the lesson plan is the main goal of this research. Table 3.16 describes the meta-affective and meta-cognitive-based training.

Table 3.16
Strategies of Meta-Affective based-Teaching (MAbT) and Meta-Cognitive based-Teaching (MCbT)

Teaching Activity	Code	Action (Meta-affective)	Code	Action (Meta-cognitive)
Opening	MAbT-1	Ask students to identify their feelings.	MCbT-1	Discuss about how do students live a happy life.
	MAbT-2	Ask students to look at themselves honestly for managing the compliment, feedback, and criticism.	MCbT-2	Discuss how do students become a respected human being.
	MAbT-3	Ask students to embrace their strengths and acknowledge their weaknesses.	MCbT-3	Discuss how do students feel good about themselves.
			MCbT-4	Give a few tips about active listening.
Main	MAbT-4	Lead students to understand that self-work and growth are positive activities.	MCbT-5	Ask students to write down three key ideas from the lecture.
	MAbT-5	Ask students to write a list of the things they like about themselves.	MCbT-6	Ask students to construct a personal learning journal.
	MAbT-6	Discuss how thoughts lead to actions and actions to feelings,	MCbT-7	Clarify about the personal learning journal.

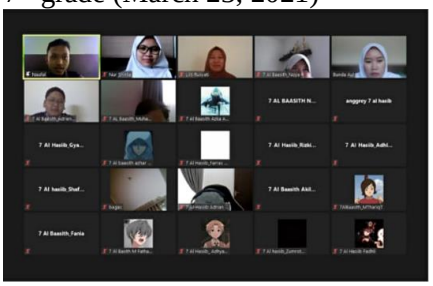
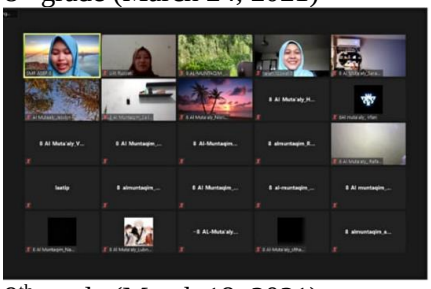
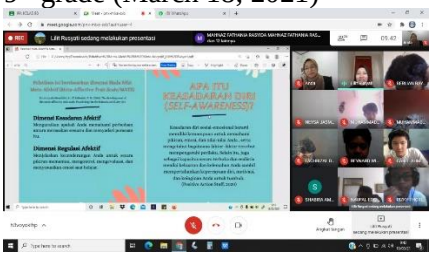
Teaching Activity	Code	Action (Meta-affective)	Code	Action (Meta-cognitive)
		which lead once again to thoughts.		
	MAbT-7	Ask students to construct a personal emotion journal and discuss it.	MCbT-8	Combine the test by using short or long essay questions.
	MAbT-8	Clarify about the personal emotion journal.		
Closing	MAbT-9	Lead students for fortifying their belief in themselves.	MCbT-9	Ask students to reflect on coursework.
	MAbT-10	Ask students to set a realistic goal and write down steps they can take to meet those goals.	MCbT-10	Ask students to recognize what they do not understand.

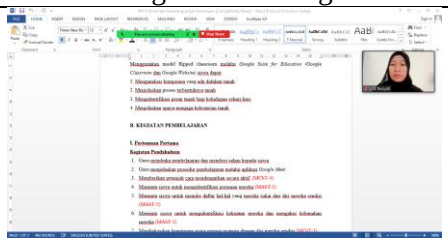
Appendix 29 explains the teacher training program attendance while Appendix 30 describes teacher training program for integrated group (https://drive.google.com/file/d/1udVNkW1uvQf18lm7ByvIwD2gccJTj2nh/view?usp=sharing). Two teacher training sessions have been held, the first of which introduced meta-affective and meta-cognitive concepts and teaching strategies. The meta-affective and meta-cognitive indicators (Table 3.16) that were included in each lesson plan were presented and discussed during the second training session. These indicators can be inserted freely by teachers into the opening, main, and closing sections. The important thing is that all of these indicators are mentioned in the lesson plan and are taught during science lessons; Table 3.16 is just one example from the researcher.

b. Training for students who learn in science in separate group.

The researcher provided meta-affective and meta-cognitive training to the separate training group of students in grades 7, 8, and 9 in these subjects. This training was delivered over the course of one meeting in a science lesson. Before beginning to study a new science topic that falls within the research period, this instruction is provided. Table 3.17 describes the implementation of actual research in integrated and separate training groups.

Table 3.17
The Implementation of Actual Research in Integrated and Separate Training

Meeting	Integrated Training	Separate Training
1	Science subject teachers who teach students in integrated training receive training on meta-affective and meta-cognitive-based teaching. Session 1 (March 7, 2021): introduced meta-affective and meta-cognitive concepts and teaching strategies. 	Researchers train groups of students in separate group. The purpose of this training is to introduce meta-affective and meta-cognitive strategies throughout an hour-long science class. Then, while studying science throughout the research time, they autonomously put it into practice. The researcher conducted this training before the students began learning with the new chapter material. 7th grade (March 23, 2021)  8th grade (March 24, 2021)  9th grade (March 18, 2021) 
2	Science subject teachers who teach students in integrated training receive training on meta-affective and meta-cognitive-based teaching. Session 2 (March 21, 2021): each lesson plan with meta-affective and meta-cognitive-based teaching was presented and discussed.	

Meeting	Integrated Training	Separate Training
		
3	A pre-test was administered to ascertain the students' beginning conditions. The online questionnaire is for assessing students' meta-affective, meta-cognitive, and transformative competencies. Appendix 31 describes the online questionnaire for the pre-test on students' meta-affective, meta-cognitive, and transformative competencies in an integrated training group.	A pre-test was administered to ascertain the students' beginning conditions. The online questionnaire is for assessing students' meta-affective, meta-cognitive, and transformative competencies. Appendix 32 describes the online questionnaire for the pre-test on students' meta-affective, meta-cognitive, and transformative competencies in a separate training group.
4	Students learn science by using meta-affective and meta-cognitive strategies with the assistance of the teacher. The data were taken from 7th grade students with the topic "Forces", 8th grade with the topic "Light and Optic", and 9th grade with the topic "Soils". The recording of full learning activities for the 7th grade integrated training group via https://drive.google.com/drive/folders/1jss3LHlUdxNi9Oi4gOSnnfgF6aRjbacI?usp=share_link, learning activities for 8th grade https://drive.google.com/drive/folders/1vJCmjZ2iEDTebIq-5icOFzc0Q2j4n0Xs?usp=share_link, and for 9th grade via https://drive.google.com/drive/folders/1sypg2gk1oM4ZvXiWoh3HhqwLWNnpmF9_?usp=share_link. Section 1 7th grade: March 29, 2021	Students learn science by using meta-affective and meta-cognitive strategies autonomously. The data were taken from 7th grade students with the topic "Forces", 8th grade with the topic "Light and Optic", and 9th grade with the topic "Soils". The recording of full learning activities for the 7th grade separate training group via https://drive.google.com/drive/folders/1JYsKVpwRW6f0wzvh6guJ24lTAKxsxbnx?usp=share_link, learning activities for 8th grade https://drive.google.com/drive/folders/1f5JHvHGrXDnrmaaLeMVsfbMcuTsb1gAl?usp=share_link, and for 9th grade via https://drive.google.com/drive/folders/1w-R9JCHd2uM1vr29klpz8GNnQH2beNHY?usp=sharing. Section 1 7th grade: March 23, 2021 8th grade: March 24, 2021

Meeting	Integrated Training	Separate Training
	8th grade: March 30, 2021 9th grade: March 16, 2021 During learning activities, students fill two types of journals, namely: Emotion journal: https://forms.gle/UjmTkoQjEqrmdxVP7 Learning journal: https://forms.gle/y4qXe8JDDts2DJAw8. (see Appendix 33)	9th grade: April 1, 2021 During learning activities, students fill two types of journals, namely: Emotion journal: https://forms.gle/UjmTkoQjEqrmdxVP7 Learning journal: https://forms.gle/y4qXe8JDDts2DJAw8 (see Appendix 33)
5	Students learn science by using meta-affective and meta-cognitive strategies with the assistance of the teacher. Section 2 7th grade: April 8, 2021 8th grade: April 1, 2021 9th grade: March 23, 2021 During learning activities, students fill two types of journals, namely: Emotion journal: https://forms.gle/UjmTkoQjEqrmdxVP7 Learning journal: https://forms.gle/y4qXe8JDDts2DJAw8 (see Appendix 33)	Students learn science by using meta-affective and meta-cognitive strategies autonomously. Section 2 7th grade: April 6, 2021 8th grade: April 5, 2021 9th grade: April 8, 2021 During learning activities, students fill two types of journals, namely: Emotion journal: https://forms.gle/UjmTkoQjEqrmdxVP7 Learning journal: https://forms.gle/y4qXe8JDDts2DJAw8 (see Appendix 33)
6	Students learn science by using meta-affective and meta-cognitive strategies with the assistance of the teacher. Section 3 7th grade: April 12, 2021 8th grade: April 6, 2021 During learning activities, students fill two types of journals, namely: Emotion journal: https://forms.gle/UjmTkoQjEqrmdxVP7 Learning journal: https://forms.gle/y4qXe8JDDts2DJAw8 (see Appendix 33)	Students learn science by using meta-affective and meta-cognitive strategies autonomously. Section 3 7th grade: April 8, 2021 8th grade: April 9, 2021 During learning activities, students fill two types of journals, namely: Emotion journal: https://forms.gle/UjmTkoQjEqrmdxVP7 Learning journal: https://forms.gle/y4qXe8JDDts2DJAw8 (see Appendix 33)
7	Students learn science by using meta-affective and meta-cognitive strategies with the assistance of the teacher. Section 4	Students learn science by using meta-affective and meta-cognitive strategies autonomously. Section 4

Meeting	Integrated Training	Separate Training
	7th grade: April 15, 2021 8th grade: April 8, 2021 During learning activities, students fill two types of journals, namely: Emotion journal: https://forms.gle/UjmTkoQjEqrmdxVP7 Learning journal: https://forms.gle/y4qXe8JDDts2DJAw8 (see Appendix 33) All sections of learning activities belong to the lesson plan with meta-affective and meta-cognitive-based teaching (see Appendix 34).	7th grade: April 13, 2021 8th grade: April 12, 2021 During learning activities, students fill two types of journals, namely: Emotion journal: https://forms.gle/UjmTkoQjEqrmdxVP7 Learning journal: https://forms.gle/y4qXe8JDDts2DJAw8 (see Appendix 33)
8	Provide a post-test to gauge the students' progress. Appendix 35 describes the online questionnaire for the post-test on students' meta-affective, meta-cognitive, and transformative competencies in an integrated training group.	Provide a post-test to gauge the students' progress. Appendix 36 describes the online questionnaire for the post-test on students' meta-affective, meta-cognitive, and transformative competencies in a separate training group.
9	Interviews with teachers to get their opinions on applying meta-affective and meta-cognitive-based teaching, particularly when it comes to assisting students with doing so.	Verify with students who independently use emotion journals and learning journals to record their meta-affective and meta-cognitive strategies.

3. Completion Stage

   a. Analyze the research's data as a whole.

      In order to assess the hypotheses, the three data (students' meta-affective, meta-cognitive, and transformative competencies) on the pre- and post-tests were analyzed using statistical tests by using IBM SPSS Statistics 25.

   b. Draw a conclusion from the data analysis findings.

      It comes to a conclusion by assessing whether or not meta-affective and meta-cognitive based-training is effective in boosting students' meta-affective, meta-cognitive, and transformative competencies. The flowchart shown in Figure 3.6 summarizes the entire process of the research procedures.

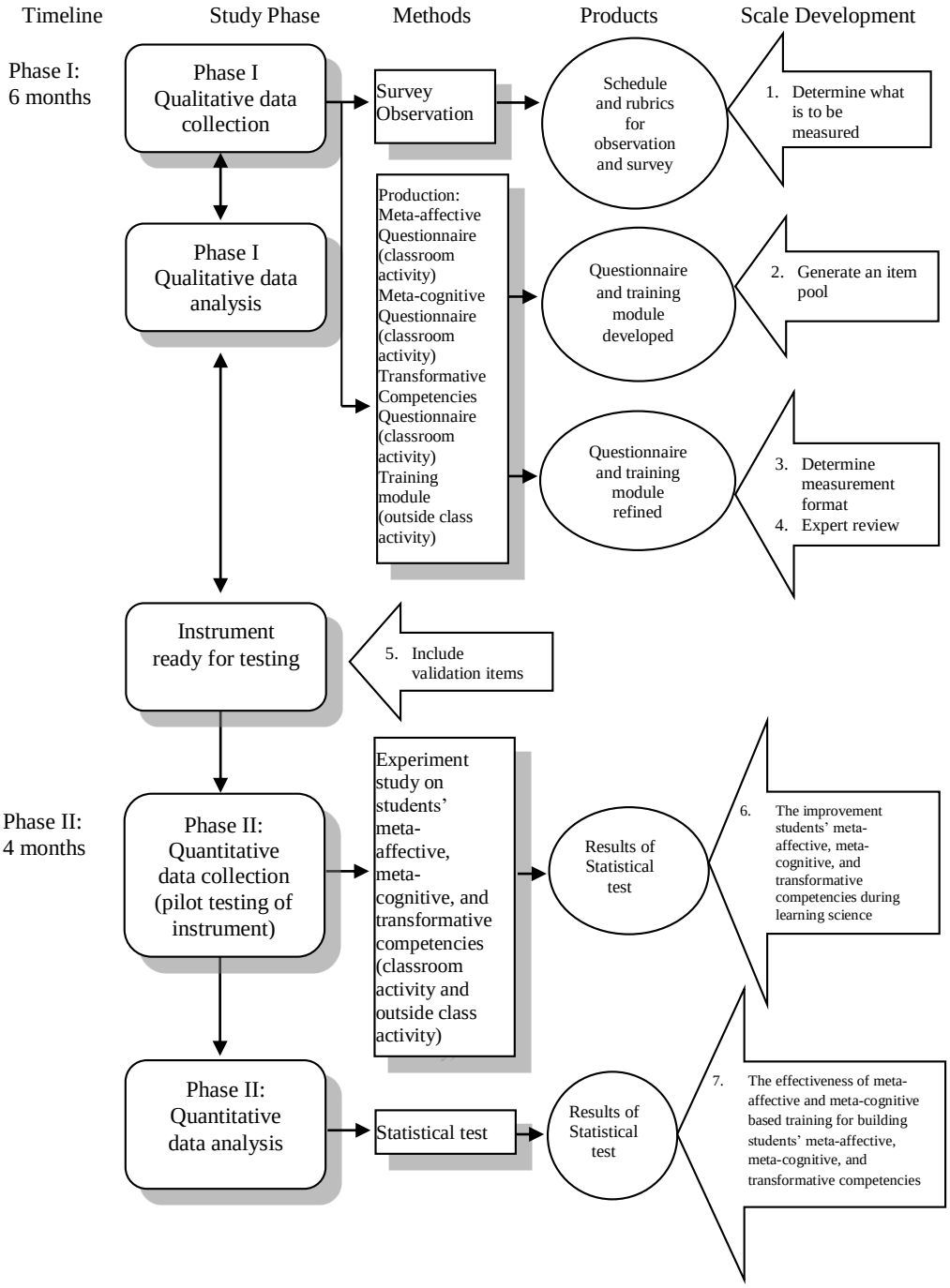


Figure 3.6
Flowchart of Research Stages

3.8 Data Analysis

3.8.1 Research Instrument Testing

The Winsteps Rasch Model was used to examine the student replies in order to determine the person reliability and item reliability index. Person and item

reliability indices are provided by the Rasch measuring model. The sample group's ability to be replicated, whereby this group will produce similar findings if the same construct is tested again, is represented by the person reliability. The item reliability index, on the other hand, shows how easily a package of items may be repeated, indicating how closely the results would be described if they were presented to a different sample group. The reliability index more than 0.8 were accepted as high value while the accepted value for reliability index is between 0.6 to 0.8 and the value which is less than 0.6 is not acceptable for reliability (Bond & Fox, 2015; Fischer & Molenaar, 2012). The internal consistency of items packaged with adequacy, such as excellent (0.90 and above), good (0.80-0.89), fair (0.70-0.79), marginal (0.60-0.69), and poor (0.59 and below) is shown by Cronbach's alpha, also known as coefficient alpha (Yockey, 2016).

The validity index explains the degree to which an item can be used to evaluate its goals. According to testing objectives, there are four different forms of validity: content validity, predictive validity, concurrent validity, and construct validity (Shepard, 1993). Validity is the extent to which theoretical justifications and empirical evidence support the tested interpretations (Messick, 1980). The degree of empirical validity as a criteria predictor depends on the connection between the answer and the criterion (Cronbach, 1946). Students' responses were analysed using IBM SPSS Statistics 25 for validity index. Value of r_{table} for 400-599 samples is 0.128 at 0.01 (1%) significance level. If the value of r_{test} (r_{xy}) > r_{table}, then the item in the questionnaire is declared valid.

Appendix 7 describes the Cronbach's Alpha as the reliability index of meta-affective questionnaire based on IBM SPSS Statistics 25. Appendix 8 provides the person reliability and item reliability index of meta-affective questionnaire based on Winsteps Rasch model. Furthermore, Appendix 12 illustrates the Cronbach's Alpha as the reliability index of meta-cognitive questionnaire based on IBM SPSS Statistics 25. Appendix 13 explains the person reliability and item reliability index of meta-cognitive questionnaire based on Winsteps Rasch model. Lastly, Appendix 17 depicts the Cronbach's Alpha as the reliability index of transformative competencies questionnaire based on IBM SPSS Statistics 25. Appendix 18

describes the person reliability and item reliability index of transformative competencies questionnaire based on Winsteps Rasch model.

3.8.2 Hypothesis Testing

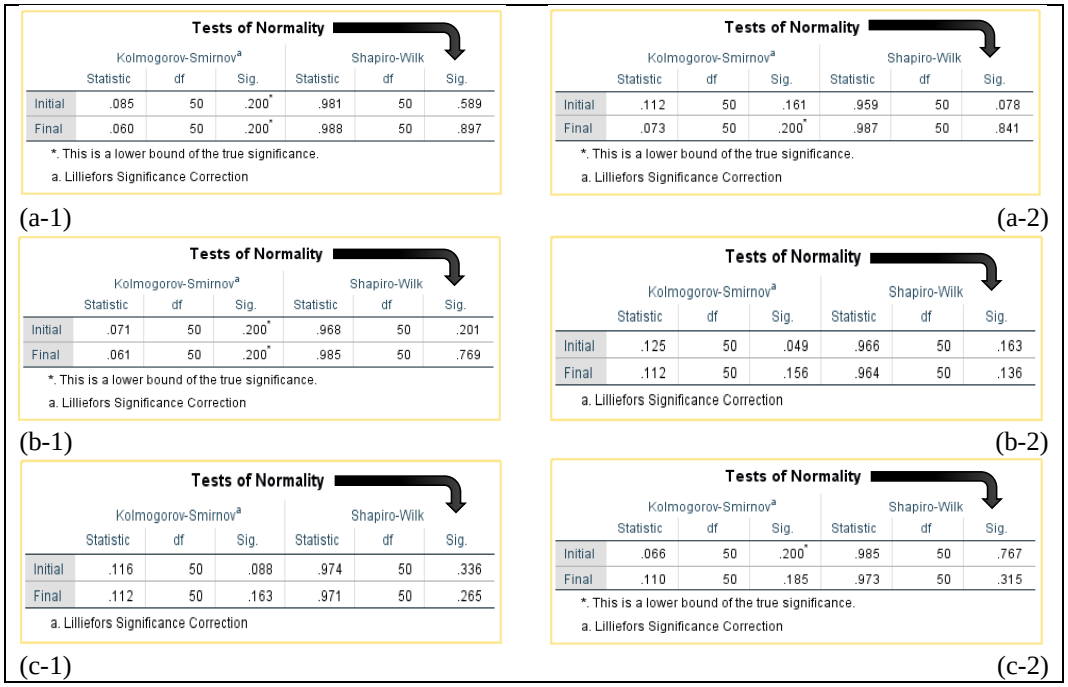
The results of descriptive statistics from analyzing the average score (mean) in the initial condition and the final condition. Furthermore, to prove whether the difference is significant or not, then proceed with the Independent-samples T Test by using IBM SPSS Statistics 25. Based on the output table, value of Sig. (2-tailed) is 0.000 < 0.05, then H_o was rejected and H_1 was accepted. In addition to comparing the significance value (Sig.) with a probability of 0.05, another way that can be done for hypothesis testing in the Independent-Samples T Test is comparing the t_{count} and the t_{table} value. Prior to testing for differences, preparatory tests, such as homogeneity and normality tests, were conducted. If all of the data are normally distributed, the parametric difference test is carried out. The difference test is then continued with non-parametric analysis if either one or both of the data are out of the ordinary.

The method must be applied in accordance with a number of presumptions, including normal distribution, homogeneity of variances, and independent observations. The lack of normality has little impact on conclusions regarding means, especially when there are enough observations in each group and the data are balanced. The breach of the equality of variances, however, can seriously affect conclusions about the means, particularly if sample sizes are not equal. As a result, the most important presumption for sensitivity of a variance analysis is homogeneity of variances. When conducting an analysis of variance, it is crucial to properly test for homogeneity of variances (Mendes & Ozcaya Turhan, 2006).

An indicator called the significance value is used in the normality test. It can be argued that the data are typical if the significance value is less than 0.05. Both Shapiro Wilk and Kolmogorov-Smirnov are equally valid. The number of samples used differs between the two approaches. Shapiro Wilk is a better choice for the normality test when the sample size is under 50. Use Kolmogorov-Smirnov to ensure more reliable results for large samples of more than 50. The validity of many

statistical processes, including parametric tests, rests on the assumption of normality, which must be verified (Ghasemi & Zahediasl, 2012).

Filling up the data in the Variable View and Data View is the initial step before performing the analysis. Fill out completely for accurate results. Then can copy and paste data that has been stored in Excel, for instance, if there is a lot of it. SPSS Normality Test procedures include: (1) select Descriptive Statistics from the Analyze menu, then click Explore; (2) insert the variable which want to test into the Dependent List column in the Explore box. Move the variable to the Factor List column if it is a qualitative variable; (3) choose Both from the Display. When necessary, add a specific number to the Confidence Interval for Mean after checking the Descriptive section. Click Continue after that; (4) select Normality plots with tests, then click Plots. If so, press OK after pressing Continue; and (5) the results of the normality test can be read for additional processing (Yockey, 2016). Figure 3.7 depicts the results of the Shapiro-Wilk normality test performed on the initial and final data of integrated and separate training groups using IBM SPSS Statistics 25.



Tests of Normality (a-1)

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Initial	.085	50	.200*	.981	50	.589
Final	.060	50	.200*	.988	50	.897

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Tests of Normality (a-2)

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Initial	.112	50	.161	.959	50	.078
Final	.073	50	.200*	.987	50	.841

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Tests of Normality (b-1)

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Initial	.071	50	.200*	.968	50	.201
Final	.061	50	.200*	.985	50	.769

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Tests of Normality (b-2)

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Initial	.125	50	.049	.966	50	.163
Final	.112	50	.156	.964	50	.136

a. Lilliefors Significance Correction

Tests of Normality (c-1)

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Initial	.116	50	.088	.974	50	.336
Final	.112	50	.163	.971	50	.265

a. Lilliefors Significance Correction

Tests of Normality (c-2)

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Initial	.066	50	.200*	.985	50	.767
Final	.110	50	.185	.973	50	.315

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

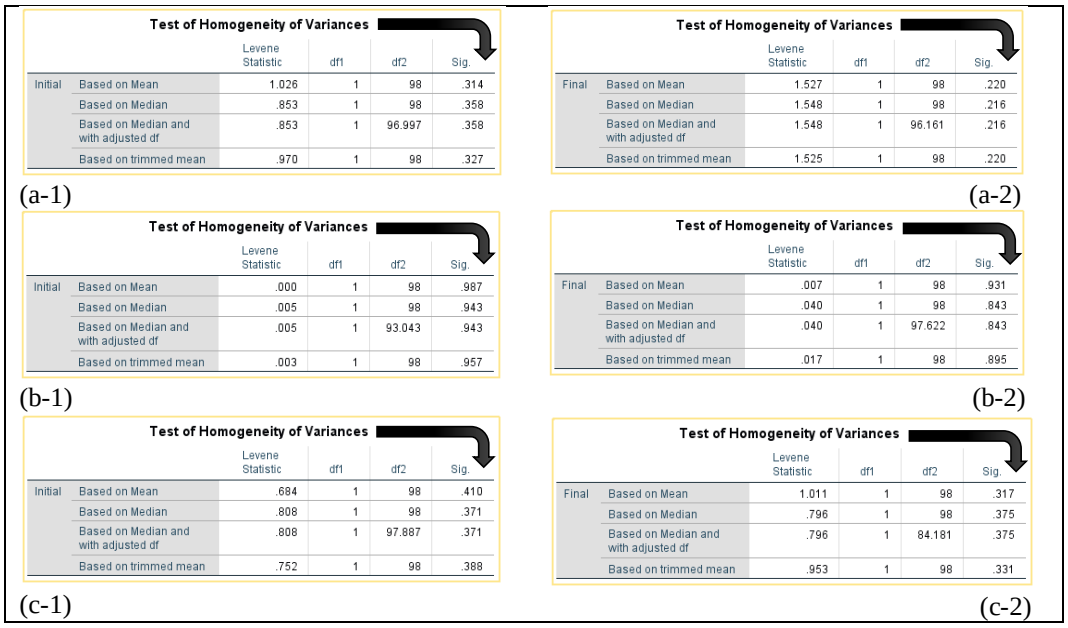
Figure 3.7
The Results of the Shapiro-Wilk Normality Test Using IBM SPSS Statistics 25
(a: students' meta-affective, b: students' meta-cognitive, c: students' transformative competencies; 1: integrated training, 2: separate training)

Based on Figure 3.7, the normality index for students' meta-affective in integrated training, the numbers .589 (initial) and .897 (final) are listed in the columns of Shapiro Wilk; their meanings are 0.589 and 0.897, respectively. Meanwhile, for separate training, the numbers .078 (initial) and .841 (final) are listed in the columns of Shapiro Wilk; their meanings are 0.078 and 0.841. These scores show that the outcome is greater than 0.05, which is the bare minimum of data that should be considered normal. A significance value of 0.589, 0.897, 0.078, and 0.841 indicates that the data is normally distributed. The normality index for students' meta-cognitive in integrated training, the numbers .201 (initial) and .769 (final) are listed in the columns of Shapiro Wilk; their meanings are 0.201 and 0.769, respectively. Meanwhile, for separate training, the numbers .163 (initial) and .136 (final) are listed in the columns of Shapiro Wilk; their meanings are 0.163 and 0.136. These scores show that the outcome is greater than 0.05, which is the bare minimum of data that should be considered normal. A significance value of 0.201, 0.769, 0.163, and 0.136 indicates that the data is normally distributed.

The normality index for students' transformative competencies in integrated training, the numbers .336 (initial) and .265 (final) are listed in the columns of Shapiro Wilk; their meanings are 0.336 and 0.265, respectively. Meanwhile, for separate training, the numbers .767 (initial) and .315 (final) are listed in the columns of Shapiro Wilk; their meanings are 0.767 and 0.315. These scores show that the outcome is greater than 0.05, which is the bare minimum of data that should be considered normal. A significance value of 0.336, 0.265, 0.767, and 0.315 indicates that the data is normally distributed. These data were followed up by tests of homogeneity of variances (Levene's tests). A homogeneity test is one that is used to determine whether two or more sample data groups are from populations with the same (homogeneous) variance. The Levene or Fisher (Bartlett) tests can be used for homogeneity analysis. Similar to the Bartlett test, the Levene test is a technique for determining the homogeneity of variation. The Levene test does not need that the data be regularly distributed, unlike the Bartlett test, but it does require that the data be continuous (Mendes & Ozcaya Turhan, 2006).

The data group comes from a population with the same variance (homogeneous), according to significance value (p) $\geq$ 0.05 (Mendes & Ozcaya

Turhan, 2006). Steps in the SPSS homogeneity test include: (1) select Analyze then Compare Means first, continue to press One-Way ANOVA; (2) fill out the Dependent List field with the variable being tested; (3) add the factor separating the groups to the Factor column. The criteria variable used in this study to distinguish between the integrated training group and the separate training group is represented in the Factor column; (4) click Options and confirm that the Homogeneity of Variance test is selected; and (5) press OK. The output pane shows the analysis findings. Figure 3.8 describes the results of the test of homogeneity of variances (Levene's tests) performed on the initial and final data of integrated and separate training groups using IBM SPSS Statistics 25.



Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Initial	Based on Mean	1.026	1	98	.314
	Based on Median	.853	1	98	.358
	Based on Median and with adjusted df	.853	1	96.997	.358
	Based on trimmed mean	.970	1	98	.327

(a-1)

Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Final	Based on Mean	1.527	1	98	.220
	Based on Median	1.548	1	98	.216
	Based on Median and with adjusted df	1.548	1	96.161	.216
	Based on trimmed mean	1.525	1	98	.220

(a-2)

Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Initial	Based on Mean	.000	1	98	.987
	Based on Median	.005	1	98	.943
	Based on Median and with adjusted df	.005	1	93.043	.943
	Based on trimmed mean	.003	1	98	.957

(b-1)

Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Final	Based on Mean	.007	1	98	.931
	Based on Median	.040	1	98	.843
	Based on Median and with adjusted df	.040	1	97.622	.843
	Based on trimmed mean	.017	1	98	.895

(b-2)

Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Initial	Based on Mean	.684	1	98	.410
	Based on Median	.808	1	98	.371
	Based on Median and with adjusted df	.808	1	97.887	.371
	Based on trimmed mean	.752	1	98	.388

(c-1)

Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Final	Based on Mean	1.011	1	98	.317
	Based on Median	.796	1	98	.375
	Based on Median and with adjusted df	.796	1	84.181	.375
	Based on trimmed mean	.953	1	98	.331

(c-2)

Figure 3.8
The Results of the Lavene Homogeneity Test Using IBM SPSS Statistics 25
(a: students' meta-affective, b: students' meta-cognitive, c: students' transformative competencies; 1: initial condition, 2: final condition)

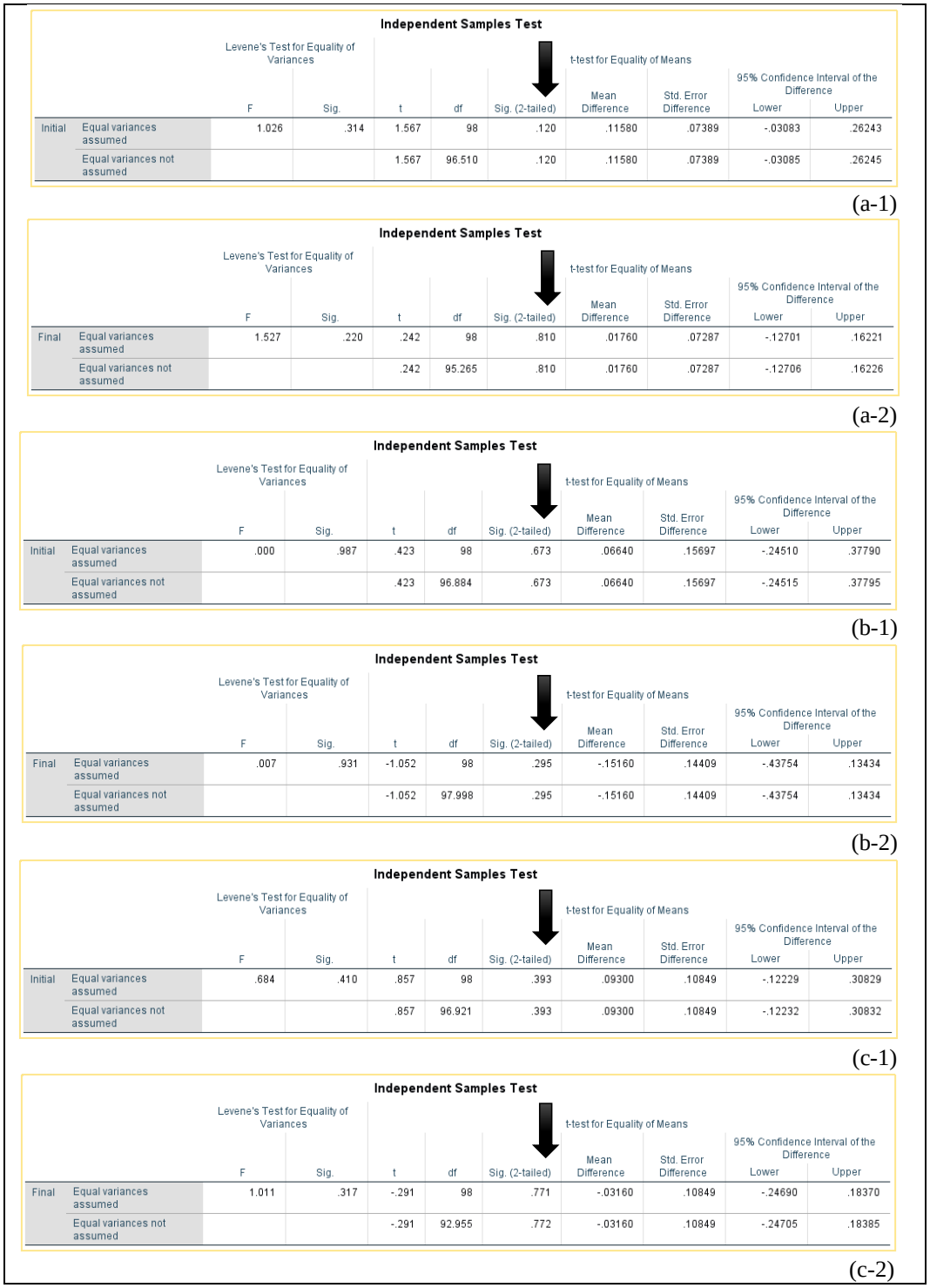
Based on Figure 3.8, the homogeneity index for students' meta-affective in the initial condition is .314 and the final condition is .220. These numbers are listed in the columns of Lavene statistics based on the mean; their meanings are 0.314 and 0.220, respectively. These scores show that the outcome is greater than 0.05, which is the bare minimum of data that should be considered homogeneous. A significance value of 0.314 and 0.220 indicates that the data is homogeneously distributed. The homogeneity index for students' meta-cognitive in the initial condition is .987 and the final condition is .931. These numbers are listed in the columns of Lavene

statistics based on the mean; their meanings are 0.987 and 0.931, respectively. These scores show that the outcome is greater than 0.05, which is the bare minimum of data that should be considered homogeneous. A significance value of 0.987 and 0.931 indicates that the data is homogeneously distributed.

The homogeneity index for students' transformative competencies in the initial condition is .410 and the final condition is .317. These numbers are listed in the columns of Lavene statistics based on the mean; their meanings are 0.410 and 0.317, respectively. These scores show that the outcome is greater than 0.05, which is the bare minimum of data that should be considered homogeneous. A significance value of 0.410 and 0.317 indicates that the data is homogeneously distributed. These data were followed up by a parametric test using an independent-samples T test. A sample that generates data from various participants is referred to as an independent sample. The significant value (2-tailed), which assesses whether there is a difference in the average of the subjects tested, serves as the foundation for determining the independent-samples T test. The significance value (2-tailed) > 0.05 indicates that there is no mean difference between research subjects. The significance value (2-tailed) <0.05 indicates that there is an average difference between research subjects (Yockey, 2016).

To compare the average of one group to a single number, the one-sample T-test is utilized (a known population mean). To evaluate whether there is a significant difference between the means of two groups, an inferential statistic known as the two-sample T-test is utilized (Liang et al., 2019). The steps for performing the Independent-Samples T test with SPSS are as follows: (1) click Analyze then Compare Means then Independent-Samples T Test; (2) in the Test Variable(s) box, choose the variable to be tested. In order to determine whether the points acquired from each group varied depending on the initial condition and final condition factors, this study investigated them; (3) select a variable for grouping. Grouping variables are those that offer traits that distinguish between different groups, such as gender, type of treatment, and others. In this research, the group type on the group variable is being used; (4) specify two distinct group types in Define Groups. Determine the types of groups to be used. This can be done by entering two values in the group variable. In this study, 1 = "integrated" and 2 = "separate"; and (5)

press OK. The output pane shows the analysis findings (Yockey, 2016). Figure 3.9 illustrates the Independent-Samples T Test results on the initial and final data of integrated and separate training groups using IBM SPSS Statistics 25.



Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Initial	Equal variances assumed	1.026	.314	1.567	98	.120	.11580	.07389	-.03083	.26243
	Equal variances not assumed			1.567	96.510	.120	.11580	.07389	-.03085	.26245

(a-1)

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Final	Equal variances assumed	1.527	.220	.242	98	.810	.01760	.07287	-.12701	.16221
	Equal variances not assumed			.242	95.265	.810	.01760	.07287	-.12706	.16226

(a-2)

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Initial	Equal variances assumed	.000	.987	.423	98	.673	.06640	.15697	-.24510	.37790
	Equal variances not assumed			.423	96.884	.673	.06640	.15697	-.24515	.37795

(b-1)

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Final	Equal variances assumed	.007	.931	-1.052	98	.295	-.15160	.14409	-.43754	.13434
	Equal variances not assumed			-1.052	97.998	.295	-.15160	.14409	-.43754	.13434

(b-2)

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Initial	Equal variances assumed	.684	.410	.857	98	.393	.09300	.10849	-.12229	.30829
	Equal variances not assumed			.857	96.921	.393	.09300	.10849	-.12232	.30832

(c-1)

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Final	Equal variances assumed	1.011	.317	-.291	98	.771	-.03160	.10849	-.24690	.18370
	Equal variances not assumed			-.291	92.955	.772	-.03160	.10849	-.24705	.18385

(c-2)

Figure 3.9

The Results of the Independent-Samples T Test Using IBM SPSS Statistics 25

(a: students' meta-affective, b: students' meta-cognitive, c: students' transformative competencies; 1: initial condition, 2: final condition)

Based on Figure 3.9, the significance value is 2-way (t-tailed) for students' meta-affective in the initial condition, which is .120, and the final condition, which is .810. These numbers are listed in the columns Sig. (2-tailed); their meanings are 0.120 and 0.810, respectively. These scores show that the outcome is greater than 0.05, so there are no significant meta-affective differences between integrated training and separate training groups. Furthermore, the significance value is 2-way (t-tailed) for students' meta-cognitive in the initial condition, which is .673, and the final condition, which is .295. These numbers are listed in the columns Sig. (2-tailed); their meanings are 0.673 and 0.295, respectively. These scores show that the outcome is greater than 0.05, so there are no significant meta-cognitive differences between integrated training and separate training groups.

Lastly, the significance value is 2-way (t-tailed) for students' transformative competencies in the initial condition, which is .393, and the final condition, which is .771. These numbers are listed in the columns Sig. (2-tailed); their meanings are 0.393 and 0.771, respectively. These scores show that the outcome is greater than 0.05, so there are no significant transformative competencies differences between integrated training and separate training groups. A presentation of the development of each response scale in each questionnaire item was done as a supporting analysis. A profile can be made by choosing which response scale best represents how each student is rated in terms of their meta-affective, meta-cognitive, and transformative competencies. Each questionnaire item's average value was also examined, and the differences between the initial and final circumstances were examined to see which items had decreased, stabilized, or increased in value. The data received from modifications to each questionnaire item is plotted on a graph so that changes to each questionnaire item in the integrated and separate training are more clearly seen. There are three categories: ideal conditions (left side increase), fixed conditions, and non-ideal situations (left side decrease).

To further clarify the research findings, interviews with teachers involved in meta-affective and meta-cognitive based education research were conducted. Three teachers in total were interviewed in order to learn more about the research's findings, particularly in light of the teachers' experiences and the conditions of their students. The interview sheet is divided into three sections: the first section

addresses the implementation of meta-affective based teaching; the second section addresses the implementation of meta-cognitive based teaching; and the third section is a teacher assessment of the viability, value of experience, and challenges related to the implementation of meta-affective and meta-cognitive based teaching. The implementation of meta-affective and meta-cognitive techniques in science learning is then clarified by an analysis of the students' replies in the Emotion Journal and Learning Journal. The open-ended questions in the emotional and learning journal are for students to freely answer depending on their own experiences. The student then translates their response, which takes the shape of a sentence, into English. Separate and combined training groups are used to categorize student replies.