CHAPTER III
RESEARCH METHOD

3.1. Kind of Research

This research is an educational design research. Plomp (2013) defined educational design research as research aimed to design and develop an intervention such as programs, teaching-learning strategies and materials, products and systems as a solution to a complex educational problem. The intervention designed and developed in this research is a didactical design on the topic of absolute value, while the complex educational problem addressed to be solved by the intervention is the building of the students' mathematical proficiencies on the topic of absolute value.

This research followed particular design research in mathematics introduced by Suryadi (2013) known as Didactical Design Research (DDR).

3.2. Subject of Research

This DDR consists of three phases namely 1) analysis of didactical situation before learning in the form of Hypothetical Didactical Design including the DPA, (2) analysis of metapedadidactic and (3) retrospective analysis that relates hypothetical didactical design with the analysis of metapedadidactic. In the phase of analyzing didactical situation before learning, the researcher studied learning obstacles of students who have learnt absolute value. The subject studied was the 11th grader students of Krida Nusantara Integrated Senior High School in Bandung Indonesia. There were 4 classes of total 87 students studied. In the phase of analysis of metapedadidactic, the researcher implemented the hypothetical didactical design toward 10th grader students of the same school. Two classes taken as subject for learning implementation in cycle 1 and cycle 2 were class X science 5 and class X science 1.

3.3. Kinds of Data of the Research

All data obtained in this DDR are qualitative. The data are in the form of:

1. The students' work on diagnostic test showing their learning obstacles on the concept of absolute value

2. The students' answer of interview as a follow up of analysis toward the students' diagnostic test result

3. Video recording of learning process during the implementation of the hypothetical design in two cycles of implementation

4. Students' answer as results of group discussion during the implementation of the hypothetical design in two cycles of implementation

5. Students' work on final test of absolute value given after implementation of the hypothetical design

6. Students' answer of interview as a follow up of analysis toward the students' answer on final test

7. Students' respond on questionnaire given after all learning activities finished

3.4. Instrument

There are two kinds of instrument in this research namely: (1) Learning Instruments and (2) Data Gathering Instrument. The learning instrument includes:

1) Learning material

2) Learning Scenario

3) Didactical and pedagogical Anticipation (DPA)

The data gathering instrument includes:

1) Problem set to diagnose student's learning obstacles in the first phase of DDR

2) Video recording equipments to capture the whole learning process during each implementation of hypothetical didactical design

3) Problem Set to assess the students' learning outcomes after the implementation of the hypothetical design.

4) Set of questions for interview as a follow up of analysis toward students' final test result

5) A Questionnaire to observe the students' opinion and attitude toward the learning material and the process of learning they have experienced

3.5. Data Analysis Techniques

The data analysis techniques for each kind of data obtained in this research will be explained in more detail as follows:

a. Data Analysis Technique for Students' Work on Diagnostic Test

The data analysis technique for students'work on diagnostic test was done in series of activities. The first activity was separating students of right answer from students of wrong answer. The researcher then focused on the students' wrong answer identifying types of answer each student gave. Students' answer of the same respond or of the same type were grouped.

The second activity was analyzing each type of students' wrong answer learning their way of thinking. Some of the answer that were easily learnt, were interpreted directly by the researcher. Some of the answer that were difficult to learn then were collected to be asked to individual or group giving those answer for more detailed information. Once all information was complete the researcher then analyzed all revealing students' wrong answer to study the source of learning obstacles. The researcher then grouped the learning obstacles into three origins of obstacles based on the categorization of Brousseau (2002) namely (1) ontogenic obstacles, (2) didactical obstacles and (3) epistemological obstacles. These analysis of learning obstacles provided fundamental idea of proposing didactical design on the topic of absolute value.

b. *Data Analysis Technique for Video Recording of Learning Process*

Analysis toward video recording of learning process was done for two main objectives. First objective is to get information about how the learning process flow from the beginning to the end. This will describe how the learning scenario applied in the real implementation. The second objective is to learn how the phases of learning namely action, formulation and validation happened in each session of learning.

The data analysis technique for video recording of learning process was done in series of activities.The first activity was watching all video recording observing all activities done by teacher and students. From this activity the researcher obtained description of how learning scenario applied in the class. The second activity was making the transcript of each video. All important dialogue spoken by teacher and students were recorded. The transcript then was analyzed to find patterns of each segment happening in each phases of learning. The segments showing the same pattern then grouped to be formulated as findings in each situation of action, formulation and validation.

c. *Data Analysis Technique for Students' Answer on Group Discussion*

The students' answer on group discussion was result of interaction of students within group and interaction between teacher and the group. The analysis toward students' answer on group discussion was done in series of activities namely (1) analyzing all answer given by each group on each question given, (2) identifying groups giving expected respond (right answer) and separating them from groups giving unexpected respond, (3) determining percentage of group giving expected respond on each question to describe how much particular mathematical proficiencies developed through the given question, (4) giving interpretation of each obtained respond.

d. *Data Analysis Technique for Students' Work on Final Test of Absolute Value*

The data analysis technique of students' work on final test was done in series of activities. The first activity was identifying type of students' respond on each question and writing number of student giving those type of answer. The second activity was interpreting each respond given by the students regarding the reason why the students gave such respond. Some responses that was easily learnt then was directly interpreted by the researcher. Some responses that was difficult to learn then were collected to be asked to the students giving such respond in the follow up interview for more clarity. Once all information was clear, the researcher then interpreted the students' respond.

The next activity was identifying the emergence of students' mathematical proficiencies especially the last three mathematical proficiencies of Killpatrick, Swafford and Findell (2001). Since each question was designed to stimulatethe emergence of particular mathematical proficiency, students who gave right answer with complete process on each question were considered to have performed their particular mathematical proficiency.The percentage of emergence of expected mathematical proficiencies was obtained by comparing the number of students giving right answer by total of the students.

e. *Data Analysis Technique for Students' Respond on Questionnaire*

The questionnaire consists of three part of questions. The first part was directed opinion in the form of Likert scale. The second and the third part were open questions asking the students' opinion about the learning activities they have experienced and asking their suggestion about mathematics learning activity they want to have in the future. The data analysis technique for students' respond on the polling of Likert scale was done in series of activities. The first activity was tabulating the number of respond for each opinion on each statement given. The researcher then grouped opinion of "Strongly Disagree" and "Disagree" as negative opinion and grouped opinion of "Agree" and "Strongly Agree" as

positive opinion. After grouping into three groups of opinion, the researcher then presented the data in the form of pie-chart diagram.

The analysis technique for open questions were reading all opinions and suggestions then grouping opinions and suggestions of the same content. The number of students giving those opinion and suggestion also recorded. Since the students' opinion were about their feeling about the learning of absolute value they have experienced, there were three categories of opinion arose namely negative opinion, neutral and positive opinion. The researcher then presented the data in the form of range in linear continuum. Comparing the two data presentation showing the students' directed opinion and the students' free opinion, the researcher then gave explanation about them. For the suggestions given by the students, the researcher also learnt the suggestions and then gave interpretation about them.

3.6. Research Procedures

The procedure in this research followed the three phases of DDR. Phase 1 is analysis of didactical situation before learning. Phase 2 is analysis of metapedadidactic. Phase 3 is retrospective analysis. The whole research procedure can be seen on the figure below:
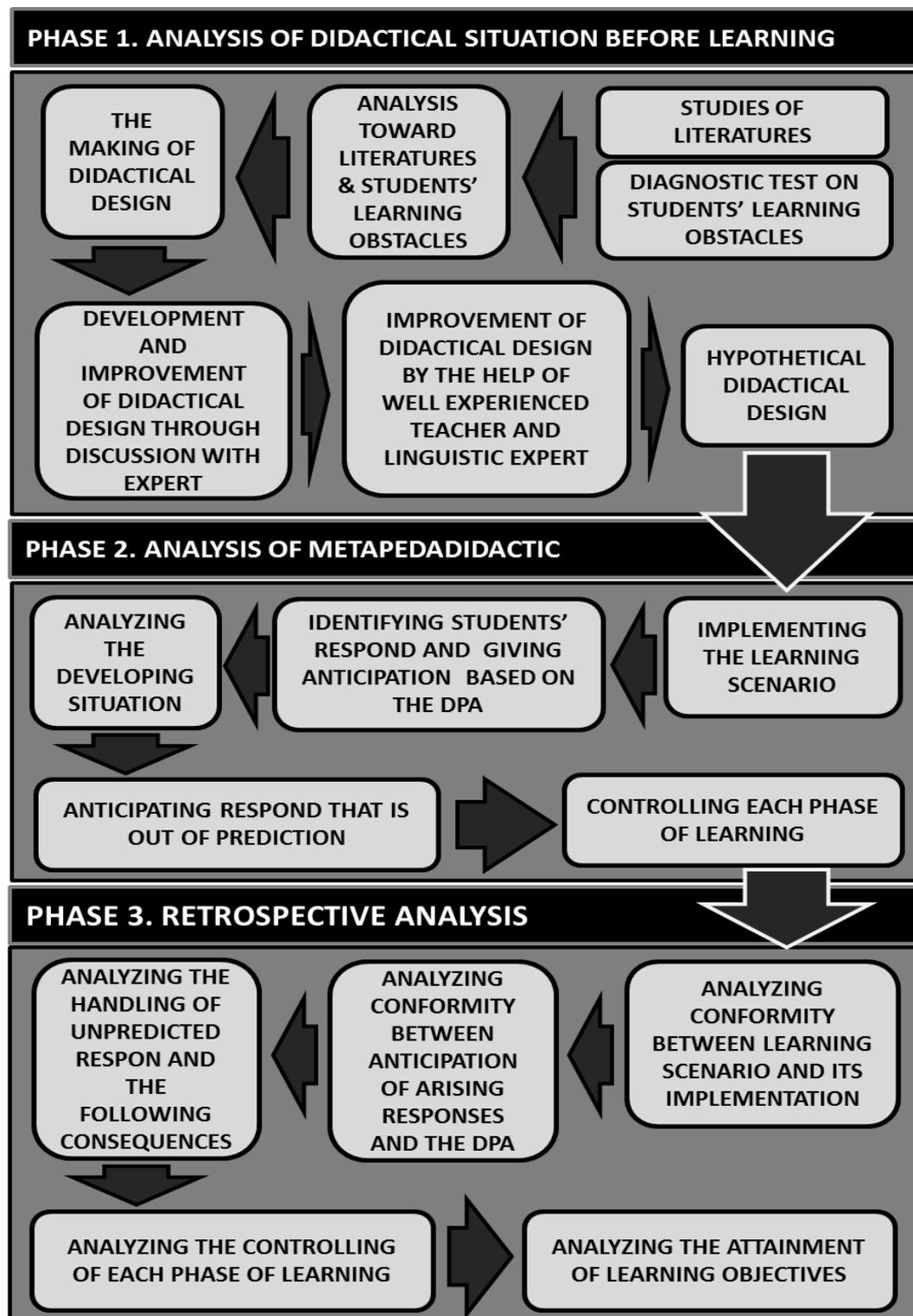
Figure 2. Research Procedure

3.6.1 Phase I : Analysis Of Didactical Situation Before Learning

At this phase, the researcher studied literatures related to didactical design research, teaching and learning absolute value and student's mathematical proficiencies. From this phase the researcher obtains several things that are (1) theoritical framework of developing didactical design through DDR, (2) students' learning difficulties on absolute value and (3) theoritical framework of how to develop students' mathematical proficiencies particularly students' strategic competence, adaptive reasoning and productive disposition.

After studying related literatures, then the researcer did a diagnostic test on students who have been thought the concept of absolute value. Students of 11th grader became subject of the test. The test was intended to diagnose the students' learning obstacles on the concept of absolute value.

The study toward existing literatures on teaching and learning absolute value and the analysis toward students' learning obstacles on diagnostic test became consideration in the process of developing didactical design. Series of activities were done in the effort of developing the didactical design namely:

1. Learning the curriculum to see the scope of material of absolute value and the time available to project how many meetings needed and how the material organized into each meeting. From this activity the researcher decided to organize the material into three learning materials given in three session of learning.

2. Determining appropriate real life contexts to be used in the learning materials then designing contextual learning material for each session of learning that provide thought stimulation for the development of students' strategic competence, adaptive reasoning and productive disposition in a constructive way

3. Planning action that is going to be given in each segment of learning and identifying all possible responses the students give toward each action given. Once all possible responses indentified, the researcher then prepared

anticipation for each possible respond didactically or pedagogically. This ctivities produced the Didactical and Pedagogical Anticipation (DPA)

4. Creating learning scenario for each learning session

The learning materials and the DPA were continuously developed and improved by the researcher through discussion with expert. The improved learning materials then were consulted with a well experienced mathematics teacher for more improvement toward the structure and the content of learning material. To make sure that the learning materials will be clearly understood by the students, the improved learning materials then were also consulted with expert of Bahasa Indonesia to check the correctness use of words, structure of language and the clarity of the messages. The final improved learning materials and the DPA then became the hypothetical didactical design that was ready to be implemented in the classroom.

3.6.2 Phase II : Analysis of Metapedadidactic

Analysis of metapedadidactic was done during the implementation of the hypothetical didactical design. There were two cycle of implementation. Each cycle consist of three session of learning. In each sesion of learning the researcher did several things namely:

1. Did all steps as planned in the learning scenario

2. Identified students' responses for each action given throuh the learning material

3. Gave appropriate anticipation toward respond arised on each group based on the DPA prepared before

4. Analyzed the developing situation to make sure all process of learning was still on the right track

5. Made a quick decision to anticipate things that out of prediction and get prepared for the coming consequences

6. Controlled the duration of each phase of learning in such a way so that all important activities were done within the available time while still gave priority to the attainment of learning objectives

3.6.3 Phase III. Retrospective Analysis

Retrospective analysis was done many times. Retrospective analysis was analysis toward several things namely: (1) the conformity between learning scenario and its implementation, (2) the conformity between the handling of arising responses and the DPA, (3) the handling of unpredicted responses and the following consequences, (4) the controlling of duration of each phase of learning and (5) the quality attainment of the learning objective. The result of retrospective analysis on one learning session became consideration to improve the quality of learning implementation of the next session.

3.7 Research Schedule

The schedule of this research can be seen as follows:

Table 1. *Research Schedule*

No	Activities	Time
Phase 1. Analysis of Didactical Situation Before Learning		
1.	Literatures Study	January 2016
2.	Diagnostic Test	March 2016.
3.	Development of Didactical Design	March 2016
4.	Improvement of Didactical Design	March 2016
Phase 2. Analysis of Metapedadidactic		
5.	Learning implementation Cycle 1	March 2016
6.	Learning Implementation Cycle 2	April 2016
7.	Final Test on Absolute Value	April 2016
8.	Questionnaire	May 2016
Phase 3. Retrospective Analysis		
9.	Analysis toward Learning Implementation Cycle 1	March 2016
10.	Analysis toward Learning Implementation Cycle 2	April 2016
11.	Analysis toward Final Test	May 2016
12.	Analysis toward Questionnaire	May 2016
13.	Writing research report	June-July 2016