Chapter 4 Research Method

In this chapter, we arranged the research into several parts: research structure, research variables, research flow, research procedure, research subject, research tool, experimental activities, and data collection and processing. Each part will be explained in detail in the following subchapter.

4.1 Research Structure and Research Variables

In this part, we explained the research variables used in the study: control variables, independent variables, and dependent variables. In this part also, we present the research architecture in Figure 12.

4.1.1 Control Variables

Control variables include learning time and learning materials. In the study, every student spent fourty minutes, twice a week (total eight weeks) to finish three kinds of fraction learning activities (fraction concept, simplification, and fraction addition/subtraction) in an authentic context. All student used the same learning materials.

4.1.2 Independent Variables

In the study, we used two groups (control group and experimental group). A detailed description of each group is as follows.

1. Control Group (CG)

   Students learned fraction concept, fraction simplification, and fraction addition/subtraction using traditional teaching method delivered by the teacher.
2. Experimental Group (EG)

   Students learned fraction concept, fraction simplification, and fraction addition/subtraction using Authentic U-Fraction

4.1.3 Dependent Variables

Dependent variables include learning behavior and learning achievements. A detailed description of each variable is as follows.

Table 2. Learning Behavior Variables

Variable Name	Description
Quantity of Assignment	The total quantity of assignment
Annotations of Assignment	The total quantity of annotations in assignment
Linguistic	Peer assessment score in linguistic scaffolding
Logical Mathematics	Peer assessment score in logical mathematics scaffolding
Visual Representation	Peer assessment score in visual representation scaffolding
Three scaffoldings & Authentic Context	Peer assessment score based on three scaffoldings and authentic context
5 Scales Rating	Peer assessment score in 5 scales rating
Teacher score	Score from the teacher assessment

Table 3. Learning Achievement Variables

Variable Name	Description
Understanding Fraction	The total score of the correct answer in the understanding fraction part
Fraction Representation	The total score of the correct answer in fraction representation part
Problem Solving	The total score of the correct answer in the problem-solving part
Posttest Score	Final Posttest score

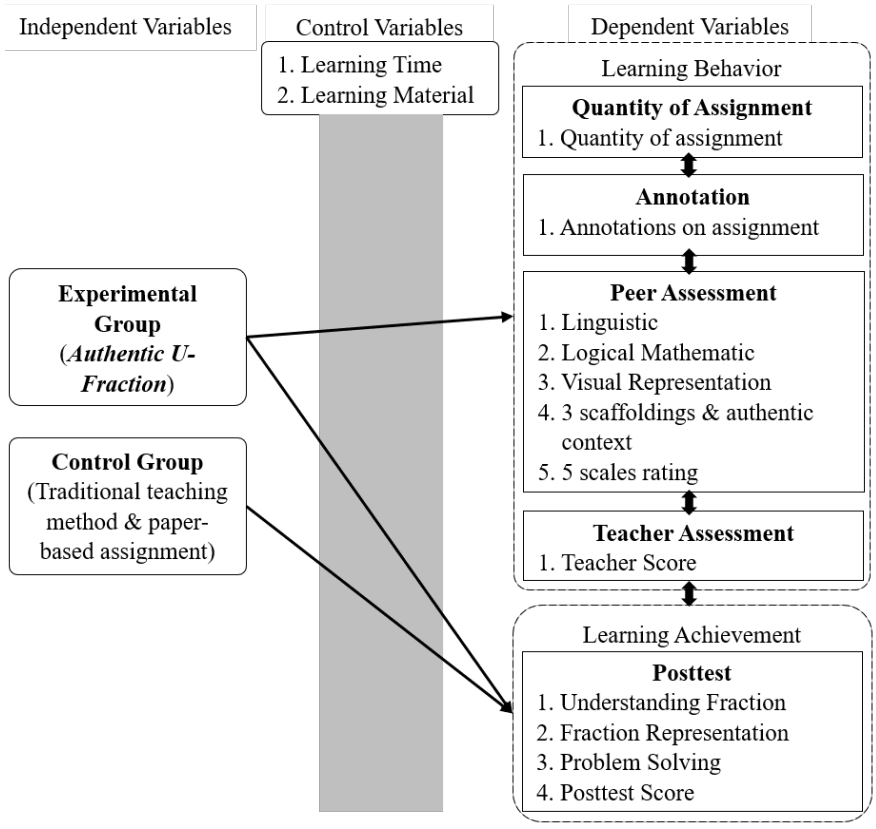

Figure 12. Research Architecture

4.2 Research Flow and Procedure

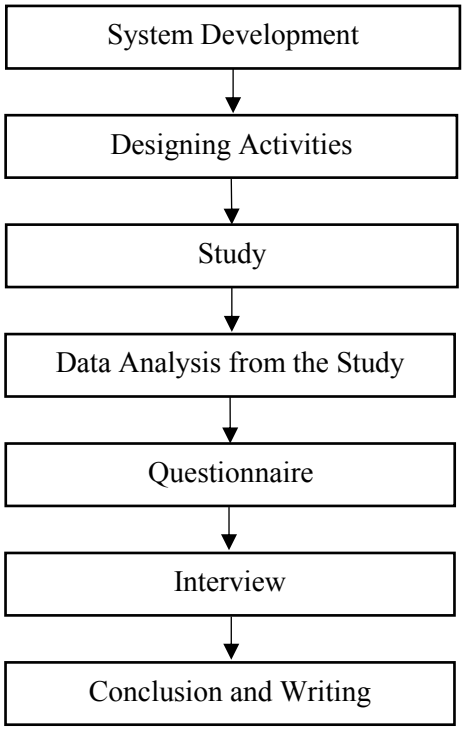

Figure 13. Research Flow

Figure 13. shows the research flow of the study. There are seven stages of the experiment that will be detailed explained are as follows.

1. System Development

   In this stage, we develop to enhance the U-Fraction app to be Authentic U-Fraction based on the three fraction learning features: concept, simplification, and addition/subtraction as well.

2. Designing Activities

   In this stage, we designed a learning activity. Students learned three topics of the fraction (fraction concept, simplification, and addition/subtraction) in an authentic environment

3. Study

   In this stage, the student started to learn fraction and to do practice using Authentic U-Fraction. Participants were fifth-grade elementary school students. In this stage also, we designed the pretest questions for pretest and post-test based on the school curriculum and discussion with the mathematics teacher.

4. Data analysis of the study

   The students' activity toward the system will be collected and stored in an online database. After that, we extracted it and analyzed the research data.

5. Questionnaire

   In this stage, we designed a questionnaire based on USE (Usefulness, Satisfaction, and Ease of Use) questionnaire and the three-dimensional authentic learning questionnaire.

6. Interview

   We interviewed several students to strengthen our findings in the study

7. Conclusion and Writing

   In this stage, we conclude and write the result of the study.

In the experiment, we conducted activities in and outside the classroom. The students need to find an object that can use for fraction learning. The research procedure presented in Figure 14.

4.3 Research Subject

Fifty-four of fifth-grade students have participated in this study. They divided into two groups: the experimental group (27 students) and the control group (27 students). A pretest applied for both groups to measure the students' prior knowledge in fraction learning. After the pretest, the experimental group continues the fraction learning using Authentic U-Fraction app, and their learning activity include two assignments and peer assessment. The two assignments; the first assignment in-class practice and the second assignment is outside the classroom and in an authentic context. After they finish the assignment, they have a peer assessment. Meanwhile, the control group using the traditional teaching method and paper-based assignment. The total learning duration of two groups is the same: 40 minutes for one class, two classes in a week, lasted in six weeks. The learning activities are done in eight weeks; in the last week, we conducted a posttest for both groups to measure the students' achievements. After that, we continue the activity with an interview. However, only the experimental group students were asked to complete the questionnaire and the interview.

4.4 Research Tool

In this study, we used pre-test to evaluate the students' prior knowledge and post-test to measure the students' achievement after the experiment. Both tests designed by mathematics teacher based on the related material in this study. Pre-test and post-test included ten items and

divided into three sections: understanding fractions, estimate and create a representation, and problem-solving. Both of post-test and pre-test have the same difficulty level of questions. The system has recorded data related to students' usage of the system. The recorded data then will be extracted to examine the student's behavior toward the system. Two questionnaires were conducted after learning activity. The first questionnaire based on USE (Usefulness, Satisfaction, and Ease of Use) was conducted to evaluate the system's usability. The second questionnaire, namely The Authentic Learning questionnaire, was conducted to evaluate the student's perception of authentic learning, creativity, happy learning, healthy learning, meaningful learning, and system sustainability & scalability. Finally, an interview session, approximately 20 minutes are employed in the last experiment.

4.5 Experimental Activities

In this study, the students' activities in the experimental group divided into two part. The first part is inside the classroom with authentic context, and the second part is around the school, also with authentic context. These two parts are explained further as follows.

1) Part One: Inside Classroom with Authentic Context.

   In this part, the students' activities divided into two: fraction learning and assignment one. The location during this activity taken inside the classroom. During fraction learning activity, the students used the fraction learning tool contained three fraction learning topic: fraction concept, fraction simplification, and fraction addition/subtraction. After that, the students will have an assignment activity that divided into six learning steps. The assignment step is as follows:

   a) Choosing a Problem

      In this step, the students must choose one problem to solve. The problem is designed based on the school curriculum and has various difficulties.

   b) Understanding Problem

      After the students choose the problem to solve, then the students must understand the problem first before they can solve it. After they understand, they can continue the step to the next.

   c) Solving Problem

      In this step, the students provided by an advanced whiteboard. The student must solve the problem with the whiteboard. They must take one or more pictures from their surrounding to solve the problem. In the whiteboard, they provided so many

tools to solve the problem. The students must solve the problem with correct representation, correct calculation, and correct annotation.

d) Describing Works

After the students finish with their whiteboard, they have to describe their works to makes it easy to identify by another student when they are doing the peer assessment

e) Describing Locations

The students must describe the location around him to their works to makes it easy to identify by another student when they are doing peer sharing.

f) Finishing Works

In the finishing works, the students confirm the app whether their work is ready to submit or not.

During the the first assignment, the system doesn't provide the google maps for the students. However, the location of students during activity always recorded by the system. The location data from students will be used in peer assessment using location-based peer-sharing.

2) Part Two: Around School with Authentic Context

In this part, the students will go outside. Four locations were chosen for this part: the school playground, school sports yard, school hall, and school classroom. The students are given with assignment but with different learning steps with the previous assignment. The students must finish the assignment in seven learning steps. The seven learning steps are as follows.

a) Choosing Location

In this step, the students must choose the nearest problem-based location from Google Maps.

b) Understanding Problem

After the students choose the location, a problem will appear on the screen. The students must understand the problem before they continue to the next steps.

c) Navigating to the Location

In this step, students must navigate their self to the chosen location.

d) Solving Problem

After the students arrived in the exact location, like assignment one, the students provided by an advanced whiteboard. The student must solve the problem with the whiteboard. They must take one or more pictures from their surrounding to solve the problem. In the whiteboard, they provided so many tools to solve the problem.

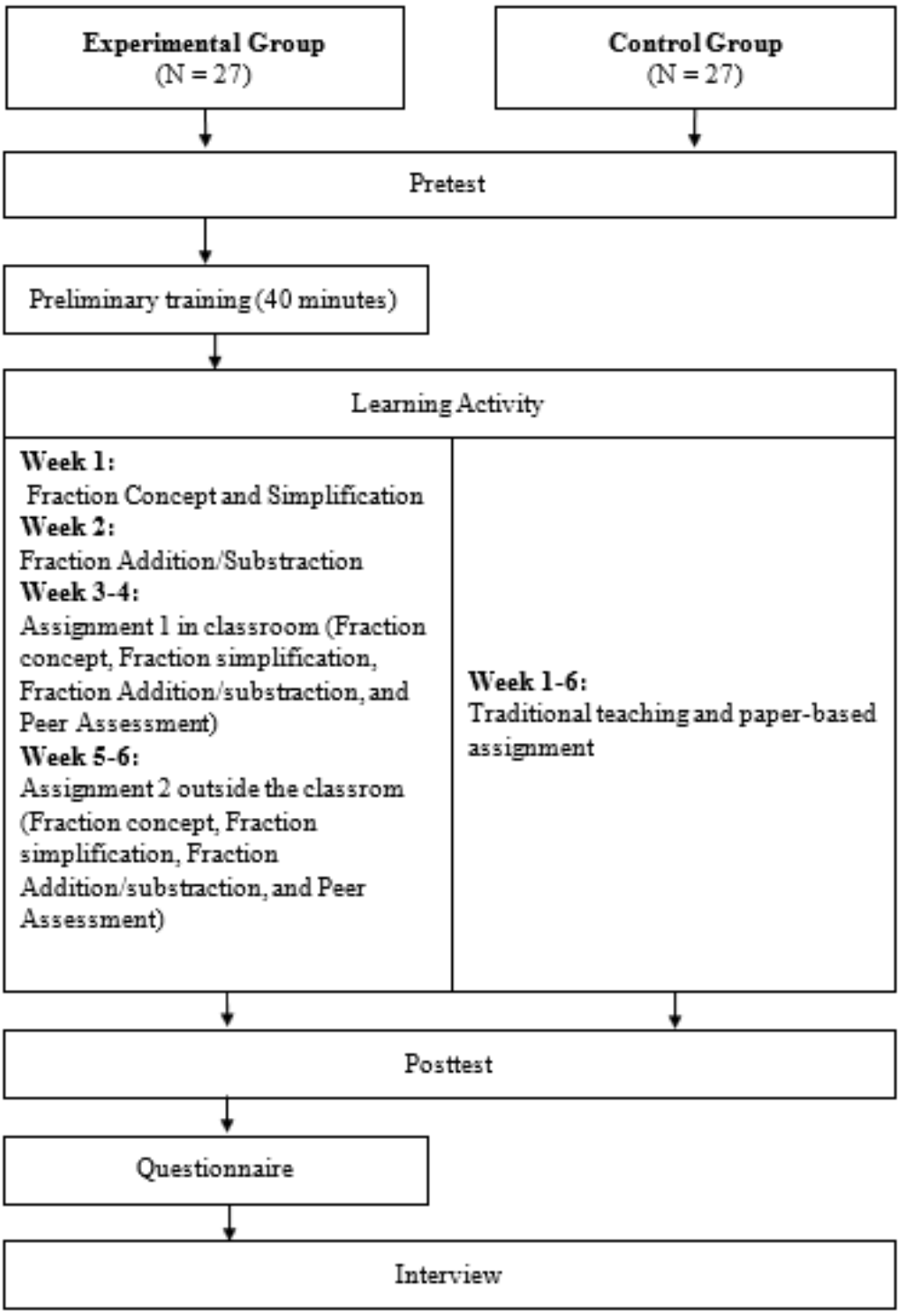

Figure 14. Experimental Procedure

The students must solve the problem with correct representation, correct calculation, and correct annotation.

e) Describing Works

After the students finish with their whiteboard, they have to describe their works to makes it easy to identify by another student when they are doing the peer assessment

f) Describing Location

The students must describe the location around him to their works to makes it easy to identify by another student when they are doing peer sharing.

g) Finishing Works

In the finishing works, the students confirm the app whether their work is ready to submit or not.

3) Peer Assessment

In this step, students use location-based peer sharing to conduct the peer assessment. Because the students must conduct the peer assessment together with authentic context. It means students must come closer to the other students' record to review the record and give assessment using The Authentic U-Fraction.

In the peer assessment, we provide the three scaffoldings and authentic context. The three scaffoldings provided in the peer assessment has a function to guide the students to give a meaningful assessment to others record. The three scaffoldings we provide consist of: linguistic, logic mathematics, and visual representation.

The linguistic scaffolding has a function to guide the students to determine the others record is correct or not from their text explanation. The logic mathematics scaffolding has a function to guide the students to determine the others record correct or not from their mathematical symbol explanation. Moreover, the last scaffolding, the visual representation has a function to guide the students to determine the others record correct or note from their fraction representation. However, before the students give a score to other records, they have to confirm the records first by coming to the location where the record recorded. So, by using this way, the peer assessment by students will be more meaningful because while they do the peer assessment, they have guidance from the three scaffoldings and authentic context.

4.6 Data Collecting and Processing

We use pretest and posttest score data to be processed in independent t-test analysis. We also analyze students behaviors toward the system. Followings are statistical analyses that are employed to analyze the experimental data.

1) Independent Sample T-test

We employ independent t-test to whether there is significance between means of two groups' pretest and posttest.

2) Pearson Product-moment Correlation and Stepwise Multiple Regression

Pearson Correlation Analysis will be employed to test whether between variables correlate. It will be used to know the correlation between learning achievement

variables and behaviors variables. Moreover, we will conduct multiple stepwise regression to predict the strongest factor in all variables.

To make the analysis easier, we design a correlation model that includes all variable (Figure 15).

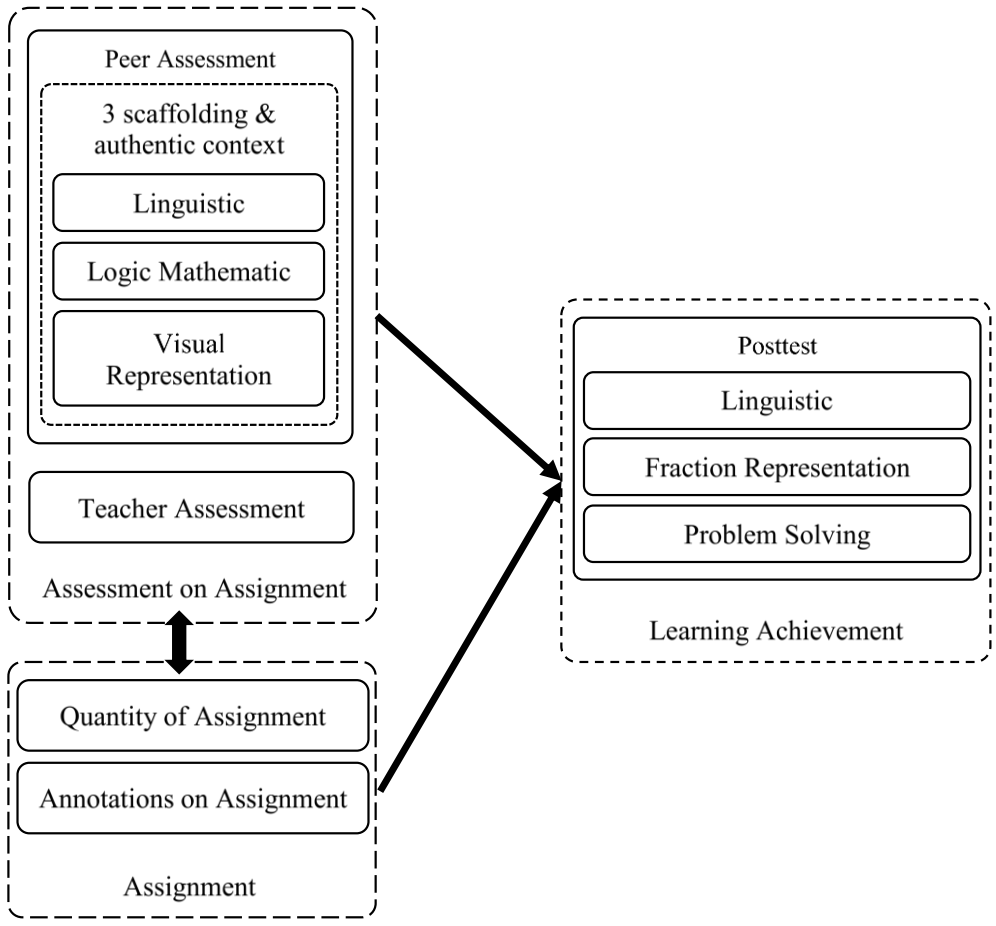

Figure 15. The correlation model between variables

The model in figure 15 will be explained more detail in the chapter result and analysis

3) Mean comparison analysis

The mean comparison will be employed to analyze the USE and The Authentic Learning Questionnaire.

4) Lag Sequential Analysis

We conduct Lag Sequential Analysis to analyze the student behavior toward the system, especially when students conduct the outside classroom activity.