Geogebra application for quadratic functions

T S Sumartini* and I Maryati
Department of Mathematics Education, Institut Pendidikan Indonesia, Jl. Pahlawan, Garut, Indonesia
*tinasrisumartini@institutpendidikan.ac.id

Abstract. The purpose of this study is to analyze the use of geogebra applications in mathematics learning on quadratic function material. In addition, it needs to be seen how respondents' conceptual and procedural understanding of the quadratic function material. This research uses quasi-experimental by taking a sample of 80 respondents. Samples were given treatment with the use of geogebra applications in mathematics learning with quadratic function material. Data analysis was performed using SPSS. The results showed that the use of geogebraic applications was effective in developing respondents' conceptual and procedural understanding of quadratic function material.

1. Introduction
At this time a lot of software that can be used to help someone in understanding mathematical material [1]. One of them is the geogebra application. This application provides knowledge that includes planning, delivery, guidance, and evaluation aimed at developing mathematical knowledge [2].

In recent years, geogebra applications have been widely used to understand mathematical material [3,4]. Geogebra is one software for understanding geometry, algebra, and calculus. Geogebra can be used as an effective and efficient visualization aid [5]. This software allows users to see algebraic forms, graphs, and spreadsheets of each mathematical object simultaneously. Therefore, the use of geogebra can develop one's conceptual and procedural understanding abilities.

Conceptual understanding involves one's understanding of the interpretation of concepts and the relationships between concepts while procedural understanding involves rules, logarithms, and procedures that must be followed in fulfilling mathematical tasks [6]. Conceptual understanding relates to facts and principles. Measurements of conceptual understanding can vary implicitly or explicitly. Implicit measures relate to evaluations where one makes definitive choices, ranks quality, and compares numbers while explicit measures relate to definitions and explanations.

Procedural understanding relates to the steps needed to solve mathematical problems that have been characterized using the construction of skills, strategies, ways, and actions. Procedural understanding is influenced by conceptual understanding because when someone completes a procedure for solving mathematical problems, he must know the concept first. Therefore, conceptual and procedural understanding develops simultaneously in one's cognitive realm and the two interact with each other. Measuring procedural understanding related to the accuracy of the answers or procedures in solving problems.

Previous research concluded that students' conceptual and procedural understanding of function material using geogebra applications was better than students in the control class [1]. Research on the effects of using geogebraic applications on conceptual and procedural understanding of quadratic
function material is still limited. Therefore, this study compares the instructional effects of learning activities using geogebraic applications on students’ conceptual and procedural understanding on quadratic function material.

2. Methods
This research method is carried out quantitatively for the effective use of geogebra applications in understanding quadratic functions. The research design used is a quasi-experimental design (The Pretest-Post-Test Non-Equivalent Group Design) [7].

In this study, the effectiveness of the use of geogebra applications on quadratic function material is seen by comparing the samples using geogebra applications with samples that do not use geogebra applications.

The sampling technique used is purposive sampling. This is based on the consideration that the school has grouped students homogeneously since class x. Samples taken as many as 80 junior high school students. As many as 40 samples were given treatment in the form of implementing learning using the geogebra application and the other 40 samples were not. Data collection is done by giving two types of pretest and posttest questions about the quadratic function material. Both types of problems are related to quadratic function problems related to conceptual and procedural understanding. Data analysis was performed using statistical tests.

3. Results and discussion
Data analysis was performed on the results of respondents’ conceptual and procedural understanding ability tests. The results of the analysis of descriptive conceptual and procedural understanding ability test data can be seen in table 1.

Table 1. Descriptive analysis of conceptual and procedural understanding ability.

| Understanding | Group   | N  | Mean | SD  |
|--------------|---------|----|------|-----|
| Conceptual   | Geogebra Pretest | 40 | 1,12 | 0,45 |
|              | Postest  | 40 | 3,28 | 0,49 |
|              | Control  Pretest | 40 | 1,17 | 0,45 |
|              | Postest  | 40 | 2,7  | 0,48 |
| Procedural   | Geogebra Pretest | 40 | 1,22 | 0,45 |
|              | Postest  | 40 | 3,37 | 0,48 |
|              | Control  Pretest | 40 | 1,27 | 0,44 |
|              | Postest  | 40 | 2,8  | 0,48 |

Table 1 shows that respondents’ conceptual and procedural understanding of the quadratic function material that obtained geogebra application-assisted learning was higher than the control class. Further analysis needs to be carried out statistical tests on the posttest data by first conducting a normality test with the results as shown in table 2.

Table 2. Data normality test.

| Understanding | Group    | Statistic | df  | Sig.  |
|--------------|----------|-----------|-----|-------|
| Conceptual   | Geogebra | 0,919     | 40  | 0,007 |
|              | Control  | 0,955     | 40  | 0,116 |
| Procedural   | Geogebra | 0,902     | 40  | 0,002 |
|              | Kontrol  | 0,955     | 40  | 0,110 |

Based on table 2, the geogebra class is not normally distributed, while the control class is normally distributed. Therefore, the next test uses the Mann Whitney test with the results shown in table 3.
Table 3. Mann-whitney test.

| Understanding | Mann-Whitney U | Z    | Sig |
|---------------|---------------|------|-----|
| Conceptual    | 293,000       | -4.917 | 0.000 |
| Procedural    | 295,000       | -4.895 | 0.000 |

Table 3 shows that at a significant level of 5% of respondents' understanding of the quadratic function material given learning assisted by geogebra applications is better than that of respondents in the control class. This means that the use of the geogebra application is effective in developing respondents' understanding of the quadratic function material. This finding supports research [8] which says that the application of geogebra effectively develops students' conceptual and procedural understanding and can improve their achievement. This is supported by the results of the pretest and posttest, which illustrate that there is a significant increase in students' conceptual and procedural understanding after learning using the geogebra application.

Geogebra applications can be used in mathematics learning and can significantly improve understanding of mathematical concepts [8,9]. This application is able to visualize the graph of quadratic functions with various features they have so that the respondent is able to understand the difference from the quadratic equation equation to the shape of the graph. For example the geogebra application helps visualize the graphic form of a quadratic function \( f(x) = ax^2 + bx + c \) by looking at the difference in values \( a, b, \) and \( c \). In addition, the application of geogebra can help someone to represent the understanding of concepts in various ways [10].

The use of the geogebra application provides opportunities for students to be independently involved in mathematical modeling, problem exploration and answering open questions [8]. This software allows users to expand the scope of their knowledge. As a result there will be interaction between teachers and students in fostering effective learning. This course will foster new understanding for students so that they can improve their performance.

Conceptual understanding is very important in learning mathematics. The use of geogebra applications prioritizes mathematical concepts that are interconnected between learning in the classroom and outside the classroom. The development of understanding is certainly inseparable from the role of adults in providing experiences to students.

Table 1 shows that the average students' procedural understanding is higher than their conceptual understanding. In this case, students rely more on formal definitions of quadratic functions and their interpretation is more on procedural applications. In addition, students are generally focused on procedural understanding to succeed in learning mathematics. This can be an obstacle in developing students' conceptual abilities. Conceptual understanding is seen not only when the respondent knows about the concept of quadratic functions but to how the respondent understands the origin of the concept.

In addition to developing conceptual understanding, the use of geogebra applications can develop a person's procedural understanding of material functions [1]. Procedural understanding is an understanding of the steps needed to solve a problem. Procedural understanding starts from the conceptual understanding possessed by the respondent. In the process of solving mathematical problems, the ability of conceptual understanding acts as the foundation of each procedure [11].

Regarding the relationship between conceptual and procedural understanding, there are several cases that can be observed. First, a person initially has a conceptual understanding and then through adult experience and guidance, he has procedural understanding and practices in solving mathematical problems. Second, a person learns procedurally in solving mathematical problems, then exploratively he gains a conceptual understanding. Third, conceptual and procedural understanding is obtained by someone simultaneously [12].

This discovery provides the reason that the application of geogebra can facilitate students in understanding the material quadratic functions. This application provides a dynamic and interactive environment and helps students make connections between algebraic representations and interpretations with graphs [13].
4. Conclusion
The GeoGebra application provides an easy way to present graphs of quadratic functions so students can understand their concepts quickly. In addition, this application is able to connect students' conceptual and procedural understanding and reduce convoluted processes or procedures. Therefore, the use of GeoGebra applications can improve students' conceptual and procedural understanding.

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