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Pupils' First Experiences on Learning Adding Fractions in GeoGebra Applet

Kuntum Sharfina Putri[1], Rinda Hidayati Akhromah[1], Zetra Hainul Putra[1*]
[1]Department of Elementary Education, Faculty of Teacher Training and Education, University of Riau, Pekanbaru, Indonesia

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ABSTRACT

GeoGebra is dynamic mathematics software that is utilized as an alternate learning media for studying Mathematics in the contemporary technology development period. Learning using GeoGebra can help students increase their knowledge of ideas and develop their mathematical thinking abilities. In this project, we apply a design research technique to create and test a GeoGebra exercise. The design study approach begins with the creation of GeoGebra-based activities on fraction addition by re-editing an existing GeoGebra design on the GeoGebra website and then testing it with five primary school students. Following the activity, we conducted interviews with students to determine the level of their comprehension of the idea of adding fractions. According to the findings of this study, pupils began to grasp and comprehend adding fractions since they could directly view how the fractions formed. However, some students continue to struggle with computer use owing to a lack of prior expertise.

Corresponding Author:

Zetra Hainul Putra
University of Riau, Pekanbaru, Indonesia
Email: zetra.hainul.putra@lecturer.unri.ac.id

INTRODUCTION

The fast advancement of science is mirrored in the advancement of information and digital technologies. As a result, technology is no longer a luxury in today's world, but rather a necessity. The advancement of science and technology may make it simpler for humans to carry out all of their everyday duties in numerous domains of life, one of which is education, specifically mathematics education (Dewey et al., 2009; Dockendorff, 2018; Putra et al., 2021; Yağmur & Çağiltay, 2013).

Mathematics is a topic that is inextricably linked to our daily life (Charles & Nason, 2000; Papadakis et al., 2021; Putra et al., 2011; Sembiring et al., 2008). The advancement of studying mathematics is matched by the advancement of technology that aids in learning mathematics (Ross & Bruce, 2009). Mathematics, on the other hand, is a discipline that tends to be abstract. Students require assistance in understanding mathematical lessons. This might be one of the reasons why Mathematics is a less popular topic (Lestari et al., 2019). Using learning media may assist teachers and students in overcoming these issues.

GeoGebra is an alternate learning tool for studying mathematics that is suited for today's digital environment (Dikovic, 2009; Kabaca, 2013; Radović et al., 2020; Weinhandl, 2020). This software can be used to improve students' knowledge of previously learned subjects or to introduce or develop new concepts. GeoGebra is regarded as an effective alternate learning medium for developing learning, particularly mathematics (Putra et al., 2021). As a result, researchers are interested in developing GeoGebra-based learning activities that can assist teachers and students in developing effective learning, assisting students in visualizing a mathematical concept, assisting teachers and students in increasing creativity, and assisting students in developing their thinking about basic mathematical concepts being studied.

In this project, we created a fraction learning activity using GeoGebra. We chose the topic because many students find it difficult to grasp, especially without visual aids. Furthermore, some pre-service and in-service primary teachers have difficulty explaining fractions to kids (Putra, 2019; van Steenbrugge et al., 2014). The usage of GeoGebra for fractions is designed to help pupils learn fundamental fraction ideas. As a result, the goal of this research is to create a GeoGebra applet for adding fractions and to learn about students' experiences with it.

METHOD

For instructional design learning, this study used a design research technique (Gravemeijer & Cobb, 2006). This strategy was chosen because it is consistent with the goal of this project, which is to create GeoGebra-based fraction learning exercises. From the standpoint of learning design, the design research process is divided into three stages: preparation, experimentation in the classroom, and retrospective analysis.

This study begins with the creation of GeoGebra-based learning activities. The proposed GeoGebra design project is the outcome of the development of existing learning activities on the GeoGebra website, which was previously designed by Trikoni (Trikoni, 2021) under the title Fraction operation - addition of fractions (figure 1). Researchers modified current activities by increasing the maximum number of fraction representations, namely the maximum numerator and denominator; each value ranges from 5 to 10. As a result, the fractional operations that may be represented are limited to those having a denominator of 10. This depiction, however, works nicely for fraction addition with a result less than 1.

Fig. 1. demonstrates the activity of adding fractions in GeoGebra. The example given is the sum of 3/5 + 1/8. The two fractions are individually represented in a square, and then each fraction is expressed as a fraction with the same denominator so that they may be joined later to form a new fraction, 29/40. This activity allows students to practice different methods of adding fractions by modifying the numerators (pembilang) and denominators (penyebut) of the two fractions.

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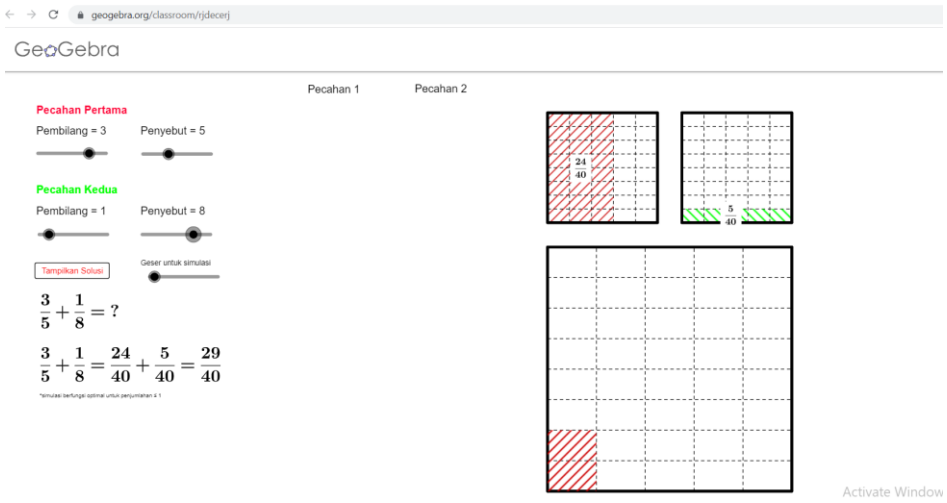

Figure 1. The representation of adding fractions on GeoGebra applet

Five children with an age range of 9 standard deviations participated in the pilot trial of the activity of adding fractions using GeoGebra. 13 years old/elementary school kids in classes 3 - 6. The experiment was carried out one at a time, with the researcher asking each participant to attempt the current exercises before observing and interviewing them about their learning experience with GeoGebra. This was done as a result of the COVID-19 pandemic.

The researchers' learning processes with the students were preceded by teaching what fractions are, where the denominator and numerator are, and fundamental inquiries concerning other fractional items. Following that, pupils were shown fraction addition via the GeoGebra website (Figure 2). On the first and second fractions, students can drag the numerator and denominator choices to calculate the fraction. After determining the two fractions, the form of the fraction will be drawn automatically (Figure 3). Following that, there is a sliding simulation option. Students can slide the choice gently to examine the process and outcome of adding two fractions (Figure 4).

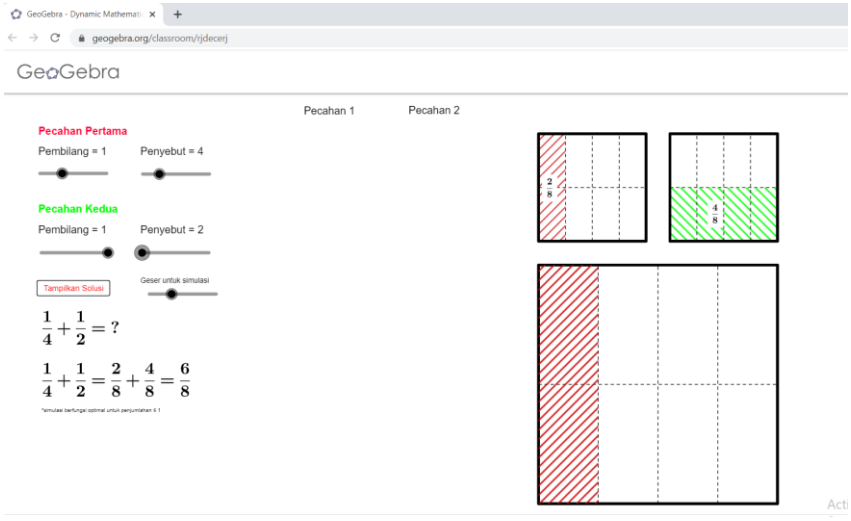

Figure 2. The diagram representation of adding fractions on GeoGebra applet

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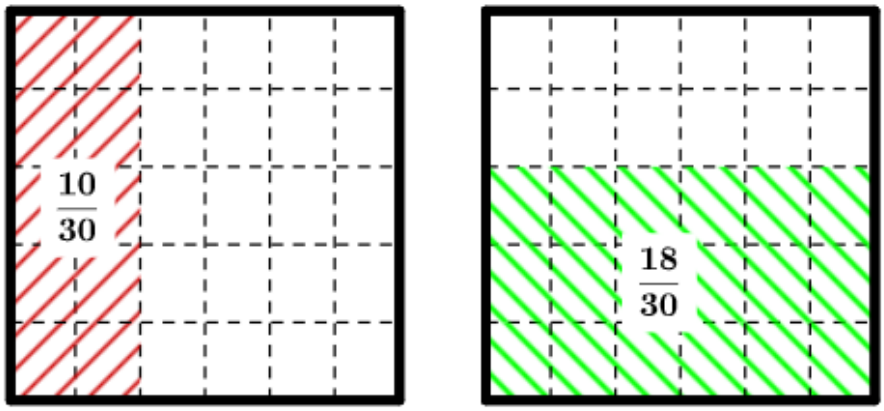

Figure 3. Visualization of two fractions on GeoGebra applet

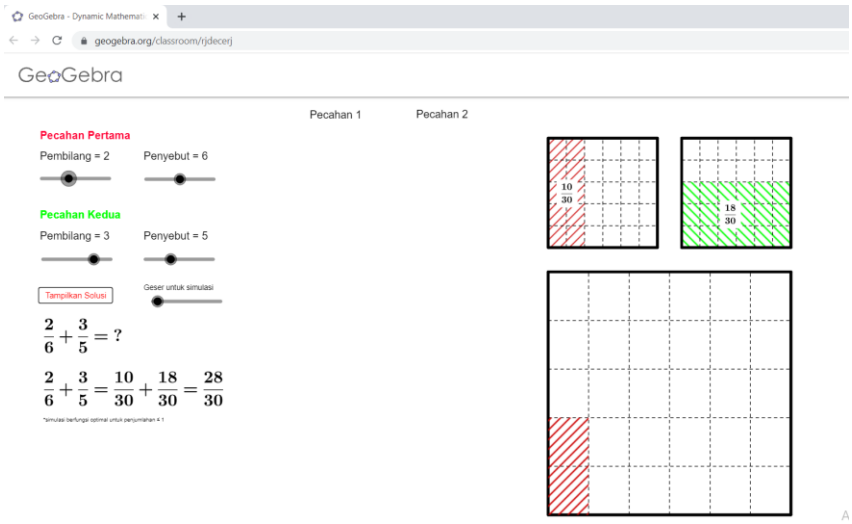

Figure 4. Visualization of adding fractions on GeoGebra applet

Following the completion of the experiment, the researchers asked the students about their experiences with the GeoGebra applet and reiterated the knowledge learned from that exercise. The interview data was evaluated to identify how students think about adding fractions and how this GeoGebra-based exercise may help them comprehend the notion of abstract fraction addition.

RESULTS

There are many replies from students based on the study done in the pilot experiment and interviews with students. The first student, student A, had a positive learning attitude after undertaking the GeoGebra project's pilot trial. When the researcher asked, "Do you understand that fractions are part of after witnessing the GeoGebra applet with fractions?" Student A answered, "Overall." The researcher then asked again, "What do you have to equate to add fractions with various denominators?" She answered, "equalize the denominator." Student A responded to the researcher's last question, "What can you grasp from what you've learnt thus far?" Based on the findings of the pilot experiment and the questions, we determined that utilizing the GeoGebra

design project, student A could grasp what was taught about fractions. Student A grasped the concept of adding fractions with various denominators by equal the number of squares in the fractions' two representations. Student A was unfamiliar with the concept of a fraction, which is a portion of a whole. She comprehended why the fractions were part of the total by imagining the shape of the fraction in the form of an image of the boxes. One challenge is that student A cannot operate or use a laptop, thus she must rely on researchers to run the GeoGebra applet.

Student B, unlike student A, is in fifth grade but still struggles with fractions. "Do you still recall the meaning of fractions?" said the researchers. "I have forgotten and do not recall it," student B said. Following the experiment and a brief explanation of fractions from the researchers, student B demonstrates which part is the denominator and which part is the numerator (Fig. 5.). When we asked, "How do you add fractions with different denominators?" Student B still had reservations. What does it imply? ". With the assistance of the researchers, Student B responded, "The denominator." The final question was, "What do you receive from studying addition with GeoGebra?" Then, student B just said that he is gaining information.

Figure 5. Student B experienced on GeoGebra applet

Pupil C, the third student, is in sixth grade. According to the findings of the pilot experiment and the questions, student C still does not comprehend the idea of fractions. When the researchers inquired, "What mathematical subject did student C notice when viewing the GeoGebra applet?" When we asked, "Do you comprehend fractions?" Student C answered, "Regarding fractions." "Forget it," she said. When the researchers inquired about the denominator and numerator, student C remained silent. Even when the researchers inquired about the denominator and numerator again at the end of the session, student C could not provide a proper answer. When we asked, "What was the same item first when adding two fractions?" student C responded, "The numerator." When we questioned, "So how do you grasp the fraction? See what you gain from the activities that you have to perform?" she said, "It is easier and more understanding, Sis, and knowing which is the denominator and which is the numerator."

Pupil D, the fourth student, is in sixth grade. Student D might get a better understanding of adding fractions based on the outcomes of the pilot experiment and the questions. "You may have learned maths in school; do you already know about fractions?" queried the researchers. When asked about the numerator and denominator, student D said, "Fractions are a type of number, part

of mathematics." When asked about the numerator and denominator, "From what you see in the box on the GeoGebra applet, attempt to indicate which one is the numerator and which is the denominator?" ", to which Student D responded, "The denominator is colored." The researchers asked, "What do you receive after what you have learned?" after doing a trial experiment and explaining the fractional material. "I understand better since the depiction of fractions on GeoGebra applet is straightforward, such as then the numerator is the shading section," said Student D. This suggests that student D could recall fractions from their GeoGebra applet depiction.

Pupil E, the fifth student, is in sixth grade. We discovered that she had improved understanding of fractions based on the pilot experiment and questions we provided her. First, the researcher said, "Have you previously grasped fractions? You could have studied it in school." Student E was still hesitant to respond. "A fraction consists of a denominator and a numerator in the form of a/b, which is the numerator and the denominator?" inquired the researchers. "The denominator is a, and the numerator is b," said Student E. She already understands that what is colored is the square's numerator. Student E has already mastered the usage of GeoGebra to manipulate media. "What do you receive after employing this GeoGebra?" the researchers inquired. "It is more clear and simpler to use GeoGebra since the fractions are depicted on the diagrams," she said.

DISCUSSION AND CONCLUDING REMARKS

Based on the findings of the GeoGebra project's pilot experiment and interviews, it is clear that GeoGebra is advantageous in mathematics learning for both students and instructors, particularly the notion of visualizing a Mathematics learning material. According to Wondo, Mei, and Seto's research [11], the GeoGebra application may be utilized in learning Mathematics as a learning medium that can illustrate and demonstrate mathematical principles in specific Mathematics learning materials.

Then, according to Hohenwarter and Fuchs (Hohenwarter & Fuchs, 2005), GeoGebra is extremely beneficial for learning mathematics; for example, as a demonstration and visualization medium, precisely, teachers may utilize GeoGebra to illustrate and visualize certain math learning ideas. Despite the fact that GeoGebra is an advanced technology that may help kids study mathematics during the Covid-19 epidemic, many students who do not have access to technological devices find it difficult to participate with several activities on the GeoGebra applet. This is because many of them never use their smartphone or laptop to learn maths. According to a study conducted by Mailizar et al (Mailizar et al., 2020) at the higher level of education, teachers believed that student level, which included student lack of knowledge and skill in e-learning use, as well as their lack of access to devices and internet connection, became barriers for them to understand mathematics in the learning process. As a result, the Indonesian government must enhance the technology infrastructure in many places and schools around the country, from kindergarten to university level.

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