Effectiveness of using The GeoEnzo Application on Metacognitive Abilities in Mathematics Learning

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Abstract. This research is an experimental study that aims to determine the effectiveness of using the GeoEnzo application. The subjects in this study were students of class XI SMK Mega Link Majene. The research instrument was used to reveal students' metacognitive abilities in understanding and solving problems on three-dimensional material. The instruments used were tests, observation sheets, and student response questionnaires. The data analysis used was descriptive and inferential statistical analysis. The results of the analysis showed that the average value of students' metacognitive abilities in understanding the material was 82.75 in the high category, while the metacognitive ability in solving questions was 85.25 in the high category. Student activities are in the very active category and student responses to learning give a very positive response. The t-test shows the sig value. (2-tailed) = 0.000 < α = 0.05, thus the application of GeoEnzo application media is effective for students' metacognitive abilities in mathematics learning.

1. Introduction
Metacognition has an important role in regulating and controlling a person's cognitive processes in learning and thinking. According to [1], in problem-solving there is a process of realizing and organizing thinking about how students make approaches to problems, choosing strategies used to find solutions, and asking themselves about these problems. This is in line with [2] research which resulted that metacognition skills also affect student intelligence and the development of these students' creative thinking processes. In more detail, [3] revealed that metacognition is divided into two components, namely metacognition knowledge and metacognition skills. Meanwhile [4], [5], and [6], according to metacognition knowledge, knowledge about cognition is generally the same as awareness and knowledge of cognition itself. This is in line with [7] and [8] which states that metacognition skills about one's awareness can plan, follow developments, and monitor the learning process [9].

Metacognitive ability is one of the dimensions of knowledge and the highest ability in taxonomy, so many researchers are interested in describing metacognitive abilities in mathematics learning [7]. [10] stated that the implementation of 21st-century learning has an impact on metacognitive regulatory skills and student achievement.
In Permendiknas RI No. 16/2007, it has been emphasized that one of the pedagogical competencies that teachers of mathematics must have is being able to utilize information and communication technology (ICT) for the benefit of learning. Unfortunately, the use of computer media in schools has not been optimized, especially in learning mathematics. Many mathematics teachers do not utilize ICT based media in learning due to time problems and the inability to utilize these media. [8], [11], [12] and [13] stated that most of the teachers in schools had not used existing mathematics applications to help to learn, most of the teachers only used PowerPoint software. In this technological era, there are many portable software and applications that can be used in mathematics learning. For example Matlab, GeoGebra, GeoEnzo, Microsoft Mathematics, Spec mathematics, and several other software. Apart from being a visualization aid, the use of technology in learning mathematics can also attract students' interest in learning and make them familiar with the technology. [11] stated that in addition to helping to create learning conditions that are conducive to the mentality of students, technology also acts as a medium or tool to simplify and accelerate the work of students, and of course provide skills in using technology (advanced skills).

One of the ICT-based media that can be used with the average facilities of students is using the GeoEnzo application. GeoEnzo is a dynamic geometric system software so that it can easily draw geometric shapes such as cones, triangles, circles, cubes, lines, and others. Using GeoEnzo learning media can facilitate the learning process of teaching mathematics and make teaching and learning activities interesting and not monotonous[14] and [15].

The results of the analysis of preliminary observations conducted by researchers at SMK Mega Link Majene, found (1) three-dimensional material is the most difficult material for students to understand, (2) teachers of SMK Mega Link Majene have never used the GeoEnzo application, (3) the average students' ability scores on three-dimensional material are in the Middle Order Thinking Skills (MOTS) category. Based on this, the researchers conducted an experiment by treating the use of the GeoEnzo application on three-dimensional material to develop the metacognitive potential of SMK Mega Link Majene students. The formulation of the problem in this study is whether the GeoEnzo application is effective on the metacognitive abilities of SMK Mega Link Majene students, especially in three-dimensional material.

2. Methods
This research is a quasi-experimental research, with the research design presented in Figure 1 below.

![Figure 1. One-group-pretest-posttest research design](image)

Where $O_1$ is the pretest, $X$ is the application of the GeoEnzo application on three-dimensional material in class XII of SMK Mega Link Majene, and $O_2$ is the posttest.

The instruments used in this study were pretest, posttest, observation sheets of the researcher's implementation in implementing three-dimensional learning using the GeoEnzo application, student activity observation sheets and student responses.

Indicators of effectiveness in this study are:

1) Minimum metacognitive ability is in the moderate category. The criteria used are based on table 1 below.

| Table 1. Criteria for Evaluating Metacognitive Abilities |
|-------------------------------------------------------|
| Category: Moderate |
| Score Range: 29-36 |

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Table 1. Metacognitive ability

| Value   | Category |
|---------|----------|
| 85 ≤ value ≤ 100 | Very high |
| 75 ≤ value < 85    | Tall      |
| 68 ≤ value < 75    | Currently |
| 55 ≤ value < 68    | Low       |
| 0 ≤ value < 55     | Very low  |

The instruments used to assess students' metacognitive were pretest and posttest. While the device used to develop metacognitive potential in three-dimensional material is student worksheets. Indicators of metacognitive ability in understanding three-dimensional material are students writing formulas, notes, summaries, and concept maps. While indicators of metacognitive ability in solving mathematical problems are students using heuristic strategies, reverse thinking strategies, advanced thinking procedures, applying inductive thinking procedures, and deductive thinking procedures.

2) Observation sheets to observe student activities during the learning process using GeoEnzo application media. Fulfill at least > 50% of student activities in the "active" category.

3) Questionnaire of student responses to learning using GeoEnzo application media. Meeting at least > 50% of students responded positively to learning after applying the GeoEnzo application.

4) The implementation of researchers in applying the GeoEnzo application to three-dimensional material. At least 75% of the activities are carried out by the teacher in accordance with the lesson plan.

Data analysis are using descriptive statistics and inferential statistics. Descriptive statistical analysis is used to describe students' mathematical representation abilities. While inferential statistics test the research hypothesis, students' mathematical representation ability of SMK Mega Link Majene is different before and after applying mathematics learning using the GeoEnzo application.

3. Results and discussion
The research was started by giving a pretest. The second, third, and fourth meetings provide treatment, namely applying to learn using the GeoEnzo application to explain three-dimensional material. Treatment is given to developing students' metacognitive abilities in understanding and solving three-dimensional questions. The fifth meeting is giving a post-test. The following is picture 2 documentation of learning using the GeoEnzo application.
Figure 2. Three-dimensional learning using the GeoEnzo application

Data on students' ability to understand problems in three-dimensional material, measured through student worksheets. Indikator kemampuan metakognitif dalam pemahaman materi dimensi tiga adalah Siswa menuliskan formula, catatan, ringkasan, dan peta konsep. The average ability of students for three times giving student worksheets is summarized in table 2 below.

| Table 2. The ability to understand problems in three-dimensional material          | Value |
|---------------------------------------------------------------------------------|-------|
| Students can highlight important formulas from three-dimensional material.      | 85.25 |
| Students can make marginal notes about concepts and principles in three-dimensional material. | 80.75 |
| Students can make summaries of three-dimensional material.                     | 80    |
| Students can make concept mapping from three-dimensional material.             | 85    |
| Average                                                                         | 82.75 |

The data collection pretest and post-test results saw in table 3 of the analysis of students' mathematical representation ability tests.
Table 3. Descriptive statistical analysis of students' metacognition ability test data

| Statistics                  | Pretest | Posttest |
|-----------------------------|---------|----------|
| Mean                        | 69.25   | 85.25    |
| Mode                        | 70      | 83       |
| Standard deviation          | 8.14    | 9.89     |
| Variants                    | 66.30   | 97.88    |
| Maximum value               | 80      | 97       |
| Minimum value               | 46      | 56       |
| The percentage of classical completeness | 71.40 | 86% |

Based on table 6, the average pretest and posttest metacognition ability has increased, this indicates that there is a change in students' metacognition after using the GeoEnzo application. This finding is in line with previous research conducted by [3], [14], and [15] which stated that learning mathematics using applications has the potential to improve students' metacognitive abilities.

The following are the results of the analysis of student activities:

Table 4. Student activity analysis

| Observed aspects                                      | 1st meeting | 2st meeting | 3st meeting |
|-------------------------------------------------------|-------------|-------------|-------------|
| Students wearing masks                                | 18          | 19          | 21          |
| Students who are present at the time of learning      | 18          | 19          | 21          |
| Students who are noisy and often disturb their friends.| 4           | 2           | 0           |
| Students who are actively working on student worksheets.| 18          | 19          | 21          |
| Students who ask questions when using the GeoEnzo application. | 11          | 9           | 8           |
| Active students answer                                | 7           | 8           | 13          |

The following are the results of the researcher's implementation of the analysis:
Table 5. Research implementation analysis

| Observed aspects                                                                 | 1st meeting | 2st meeting | 3st meeting |
|----------------------------------------------------------------------------------|-------------|-------------|-------------|
| Researchers ensure health protocols                                              | Implemented | Implemented | Implemented |
| Researchers convey learning objectives                                           | Implemented | Implemented | Implemented |
| Researchers convey the benefits of three-dimensional material in everyday life, build creativity, think logically, and skillfully use computers. | Implemented | Implemented | Implemented |
| The researcher conveys the GeoEnzo application that will be used in three-dimensional learning. | Implemented | Implemented | Implemented |
| Researchers guide students who have difficulty in working on student worksheets. | Implemented | Implemented | Implemented |
| Researchers provide opportunities for students to ask questions that have not been understood. | Implemented | Implemented | Implemented |
| Researchers provide opportunities for some students to present the results of their work. | Implemented | Implemented | Implemented |
| Researchers give reinforcement to the percentage of students.                     | Implemented | Implemented | Implemented |
| Researchers reward students who answer correctly.                                | Implemented | Implemented | Implemented |
| Researchers together with students summarize the material that has been studied. | Implemented | Implemented | Implemented |
| The researcher closed the lesson, by motivating students to continue learning, maintaining health and complying with health protocols and saying greetings. | Implemented | Implemented | Implemented |

Inferential statistical analysis for normality test obtained data presented in table 6 below.

Table 6. Analysis of data normality test

| Postes   | Kolmogorov-Smirnov | Shapiro-Wilk |
|----------|--------------------|--------------|
|          | Statistic   | Df | Sig.     | Statistic | Df | Sig.     |
|          | 0.149       | 42 | 0.019    | 0.959      | 42 | 0.135    |

From the analysis results, the sig value obtained = 0.135 > α = 0.05. it means that the data normally. The statistical hypothesis test analysis results using the t-test can see in table 7 below.

Table 7. Analysis of the t-test

| Postes | T   | df | Sig. (2-tailed) | Mean Difference | 95% Confidence Interval of Difference |
|--------|-----|----|-----------------|-----------------|--------------------------------------|
|        | -4.451 | 40 | 0.000           | -14.905         | Lower -21.715 Upper -8.095          |
From the analysis, it was obtained that the sig (2-tailed) value = 0.000 < \alpha = 0.05, meaning that there were differences in students' mathematical metacognitive abilities before and after the application of GeoEnzo applications. Based on the research results, it is known that the application of GeoEnzo applications is effective on students' metacognition abilities. This finding is in line with [11] the application of ICT-based media has the potential to improve the quality of mathematics learning in schools, both in understanding and solving students' math problems, so that metacognitive abilities can be maximized.

4. Conclusion

GeoEnzo application is an alternative that can be used as a medium for learning school mathematics. Based on the results of the study, it was found that (1) the average metacognitive ability of students after applying the GeoEnzo application was in the high category, (2) positive student activities were above 50%, (3) aspects of the implementation of learning were 100% in accordance with the learning implementation plan, and (4) student responses are in the very positive category. These findings are in accordance with the indicators of research effectiveness, it can be concluded that the use of the GeoEnzo application on three-dimensional material is effective on the metacognitive abilities of the students of SMK Mega Link Majene.

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