Application of ADDIE Learning Model Assisted by Desmos Application to Improve Ability to Understand Mathematical Concepts

Jihan Rofifah¹, Benny Hendriana²
¹,² Muhammadiyah University Prof. Dr. Hamka, Indonesia
E-mail correspondence: rofifahjihan31@gmail.com
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Abstract

This study aims to improve students' understanding of mathematical concepts using the application of the ADDIE learning model assisted by the desmos application. This research is a Classroom Action Research. The research subjects consisted of 36 students of class X-D SMAN 83 Jakarta. Data collection techniques used description test instruments, observation sheets, and documentation. Data analysis used quantitative and qualitative descriptive analysis. Researchers conducted initial observations (pre-cycle) and two learning cycles. An observer assessed the activities of educators and students in each cycle. The results stated that students experienced an increase in the ability to understand mathematical concepts seen from the pre-cycle percentage of 13.89%, cycle I of 66.67%, cycle II of 83.33% and reached the KKM score ≥78 and in accordance with the research target of 80%. This is supported by the activities of students and the activities of educators who also experienced an increase in each cycle in the good category. So it can be said that using the application of the ADDIE learning model assisted by the desmos application can improve the ability of students' understanding of mathematical concepts in trigonometry material.

Keywords: Concept Understanding; ADDIE model; Desmos

1. Introduction

Mathematics is the highest science. Mathematics is one of the few sciences taught systematically from elementary to college level (Mutaqin et al., 2023). Some Indonesian students always shy away from mathematics. In everyday life, we cannot avoid anything related to mathematics. With this it is known that mathematics plays an important role for education. Correspondingly, a goal of learning mathematics is to understand concepts (Pratiwi & Tsurayya, 2023). Every student's basic skills in learning mathematics start with conceptual understanding (Sunarto et al., 2021). Conceptual understanding is the foundation of Higher Order Thinking Skills (HOTS) (Hendriana, 2019). (Setiawan et al., 2023; Utami & Kusumah, 2023) Find low scores in students' ability to understand. There are factors that result in the ability to understand mathematical concepts are not optimal, namely students do not have the opportunity to get a further understanding of the material taught (Praja et al., 2021). Thus, students are accustomed to learning by memorizing but not understanding (Maknun et al., 2021). Even though understanding the concept of learning mathematics is more important than just memorizing the material (Fahrudin et al., 2018). In line with that, in general, failure to learn mathematics is caused by students do not understand mathematical concepts and are unable to solve mathematical problems (Arifin et al., 2023).

Based on the results of the initial observation description test (pre-cycle) in class X-D SMAN 83 Jakarta, it was found that the number of students who were able to understand mathematical concepts
with a complete category of 5 people and incomplete 31 people with a completion percentage of 13.89%, thus the ability to understand mathematical concepts in the class was classified as a low category. This happens because classroom learning is still centered only on educators which causes low ability to understand mathematical concepts in the classroom. When learning takes place, students are still passive because during learning educators only provide material through the lecture method, students rarely ask questions or express opinions. Intergroup discussions rarely occur so that interaction between students or educators is still not established during the learning process. In line with that, teacher-centered learning causes: (1) students are not interested in learning and feel lazy, (2) student activities when in class are less productive, (3) students are still confused in solving problems from educators, (4) students only follow instructions from educators when solving problems, (5) students are less creative in solving problems, and (6) learners are accustomed to cheating answers from their peers (Syarifuddin, 2020).

The high ability of students to understand mathematical concepts if they can apply, remember, sequence back the ideas that have been learned and can solve mathematical problems (Nuraeni & Nugraheni, 2022). Correspondingly, when they are able to meet the indicators, then they are considered to have mathematical comprehension skills (Sari et al., 2023). Thus, the indicator of the ability to understand mathematical concepts becomes one of the clues in a learning achievement. Indicators of understanding mathematical concepts are being able to understand, recognize, and prioritize mathematical procedures, concepts, and principles and ideas (Arifin et al., 2023). Researchers adopt indicators of the ability to understand mathematical concepts from several studies and formulate the indicators into: (1) rearrange concepts, (2) determine the characteristics of processes or ideas, (3) maintain concepts learned with counterexamples, (4) display ideas with a number of mathematical symbols, including tables, graphs, diagrams, and figures (Ardila et al., 2022; Gusmania & Agustyaningrum, 2020; Praja et al., 2021; Sibarani et al., 2021).

Solutions to solve these problems need to be improved to the learning process with a learning model system. The learning model itself is a tool that supports and supports the learning process. ADDIE is one example of a new approach to education (Rosita, 2019). The ADDIE model is a learning system with a simple and easy to learn basis (Pribadi, 2009). This learning model has a systematic, efficient, effective approach and produces an interactive process (Darsono et al., 2019; Hidayat & Nizar, 2021; Marbun, 2021) and can create innovative teaching and learning activities when educators can elaborate between teaching materials and media (Ulum et al., 2020).

The ADDIE model is commonly used as a development model however, there are some studies such as (Amarullah & Wahidah, 2021; Arini et al., 2013; Asmara, 2021; Darsono et al., 2019; Dewi et al., 2013; Dwipayanti et al., 2013; Hidayat & Nizar, 2021; Istiqomah et al., 2022; Rosdianto et al., 2019; Rosita, 2019; Siwardani et al., 2015; Subur & Rahayu, 2021; Ulum et al., 2020; Wijayanti, 2016). What makes the Addie model a learning model is reinforced by the statement (Molenda, 2003) which states there is no original and authoritative version of the ADDIE model that can be revealed and interpreted, there is no real or authentic meaning for the term, anyone is free to embed whatever attributes they want on this label as they see fit. So researchers apply the ADDIE model as a learning model system.

In addition to requiring the right learning model system, educators can use media to make lesson concepts more interesting, effective, and efficient is one way to make learning fun and more meaningful (Hendriana, 2019). In line with that, educators can also use various latest technologies, one of which is the Desmos application which is an online and free graphing calculator for educators and students (Taufik & Pagiling, 2021). It is of course ideal for efficient and effective visualization of abstract mathematical objects. Especially mathematics subjects trigonometric material that requires graphic visualization (Ishartono et al., 2018). This site is able to help educators visualize the subjects they teach so as to make learning more fun. Ultimately, educators can provide learners with a level of proficiency in operating sites that they can use independently to find out more about the math topics they teach. Thus, the skill of operating the Desmos application is important for mathematics educators in high school.

Based on this presentation, researchers want to investigate the potential of Addie’s learning model to improve student understanding. The difference between this research and the previous one lies in the subject used is X-D class students at SMAN 83 Jakarta with trigonometry material and also examines
how educators and students work on addie learning. The novelty of this study is using the help of the media application desmos.

2. Method

The research method used is classroom action research. This study chose the model (Arikunto et al., 2007) because researchers argue that there needs to be an initial observation stage (pre-cycle) to identify problems in the classroom before conducting research. The following is an overview of the stages of the arikunto model cycle.

Figure 1. Action Reserch Model Suharsimi Arikunto

There are four stages of the classroom action research cycle, namely: planning, implementation, observation, and reflection. After carrying out the pre-cycle, researchers carried out cycles I and II. The subjects of the study were 36 students from class X-D SMAN 83 Jakarta, 14 of whom were men and 22 of them were women. The material provided is trigonometric material, because this material is mostly about story problems, so they need mathematical literacy to overcome these problems.

Data collection methods include test and non-test instruments, both of which have been validated by a teacher and an expert lecturer in mathematics. Test instruments such as test sheets, descriptions of the ability to understand mathematical concepts in each cycle, as well as non-test tools such as observation sheets, student and educator activities, and documentation. Data analysis through quantitative descriptive analysis examines the results of student tests conducted at the end of each cycle. Meanwhile, qualitative data analysis is analyzing the results of observations of student and educator activities.

Quantitative descriptive analysis is used to measure the increase in the capacity of learners in understanding mathematical ideas on trigonometric content in classes X-D. This research uses learning tools such as teaching modules by applying the ADDIE and LKPD learning models applied through the Desmos application. Using formula 1 below, calculate the value of each indicator of understanding mathematical concepts.

\[
\frac{\text{Total score for each indicator}}{\text{The maximum score for each indicator}} \times 100 \quad \text{(1)}
\]

Source: (Yuliani et al., 2018)

Table 1 shows the categories of values for the ability to understand mathematical concepts in each indicator.
Table 1. Value Category Ability to Understand Mathematical Concepts

<table>
<thead>
<tr>
<th>Value</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>85,00 – 100</td>
<td>Excellent</td>
</tr>
<tr>
<td>70,00 – 84,99</td>
<td>Good</td>
</tr>
<tr>
<td>55,00 – 69,99</td>
<td>Enough</td>
</tr>
<tr>
<td>40,00 – 54,99</td>
<td>Low</td>
</tr>
<tr>
<td>0,00 – 39,99</td>
<td>Very low</td>
</tr>
</tbody>
</table>

*Source*: (Argawi & Pujiastuti, 2021)

Calculate the completeness value of the ability to understand individual mathematical concepts of students with formula 2.

\[
\text{score} = \frac{\text{Score}}{\text{Maximum score}} \times 100 \quad (2)
\]

*Source*: (Yuliani et al., 2018)

Adapun kategori ketuntasan belajar yang di sesuaikan dengan KKM sekolah tersebut pada Tabel 2. The category of learning completeness is adjusted to the school's KKM in Table 2.

Table 2. Categories Completeness

<table>
<thead>
<tr>
<th>Value</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 78</td>
<td>Complete</td>
</tr>
<tr>
<td>&lt; 78</td>
<td>Incomplete</td>
</tr>
</tbody>
</table>

KKM = 78

Calculate the percentage of completion results of the description test with formula 3 as follows:

\[
\text{Percentage} = \frac{\sum \text{students who have completed their studies}}{\sum \text{students}} \times 100 \quad (3)
\]

*Source*: (Miria & Fahriza, 2022)

The results of the calculation of the percentage of results of the ability to understand mathematical concepts, then categorized into table 3.

Table 3. Category Percentage Results Ability to understand mathematical concepts

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>0% - 39%</td>
<td>Very low</td>
</tr>
<tr>
<td>40% - 54%</td>
<td>Low</td>
</tr>
<tr>
<td>55% - 74%</td>
<td>Keep</td>
</tr>
<tr>
<td>75% - 89%</td>
<td>Tall</td>
</tr>
<tr>
<td>90% - 100%</td>
<td>Very high</td>
</tr>
</tbody>
</table>

*Source*: (Septripiyani & Novtiar, 2021)

After quantitative descriptive analysis, then researchers analyze qualitative data. Qualitative data analysis using observation sheets of student learning activities and educators' teaching skills in mathematics learning with the ADDIE learning model assisted by the Desmos application media. The collected data is then evaluated by calculating the score according to the following formula 1.

\[
\text{score} = \frac{\text{descriptor appears}}{\text{maximum amount}} \times 100 \quad (4)
\]

*Source*: (Miria & Fahriza, 2022)

Calculate the average value of the ability to understand mathematical concepts with formula 2 below.

\[
\text{average score} = \frac{\text{total score obtained}}{\text{number assessment indicators}} \quad (5)
\]

*Source*: (Yuliani et al., 2018)

Table 4. Percentage Category of Observations

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>85% – 100%</td>
<td>Excellent</td>
</tr>
<tr>
<td>70% – 85%</td>
<td>Good</td>
</tr>
<tr>
<td>65% – 70%</td>
<td>Enough</td>
</tr>
</tbody>
</table>
The achievement of the researcher's target is 80% completeness of students in class X-D who have increased the ability to understand mathematical concepts so that student learning activities and educator teaching skills activities also increase to reach a score of 80% with good criteria being a benchmark for success in this study.

3. Results and Discussion

The study lasted for two cycles, each consisting of two meetings. The main results of this study consisted of observations of student activities and educator activities, as well as tests describing the ability to understand mathematical concepts in trigonometric material. The inaugural meeting of the first cycle will be on Tuesday, March 28, 2023. The activities of educators and learners are assessed by an observer. The following are observations of cycle I activity contained in paragraph 5 below.

<table>
<thead>
<tr>
<th>No</th>
<th>Types of activities</th>
<th>Cycle I</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Student activities</td>
<td>Score 43, Percentage 63.24%, Category Less</td>
</tr>
<tr>
<td>2</td>
<td>Educator activity</td>
<td>Score 82, Percentage 78.85%, Category Good</td>
</tr>
</tbody>
</table>

In Table 5, the results of the analysis showed that student activities obtained a score of 43 with a percentage of 63.24% in the less category. Meanwhile, educator activities obtained a score of 82 with a percentage of 78.85% in the good category. The second meeting takes place on March 30, 2023. Researchers provide a cycle I description test to find out the improvement of students' ability to understand mathematical concepts. The analysis data are shown in Table 6.

<table>
<thead>
<tr>
<th>Number of learners</th>
<th>Complete</th>
<th>Unfinished</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>36</td>
<td>24</td>
<td>12</td>
<td>66.67%</td>
</tr>
</tbody>
</table>

Based on the KKM determined by the school, students are considered complete learning when the results of the description test obtain more than or equal to 78. In Table 6, the results of the analysis show that of 36 students who obtained the completeness category, 24 people with a percentage of 66.67%. This shows that most learners have reached KKM. However, it has not reached the research target with a percentage of 80%. Therefore, this study needs to be revisited. Before continuing in cycle II, researchers need to analyze problems or shortcomings in cycle I by conducting analysis at the reflection stage.

Based on reflection on the first cycle, it is known that there are shortcomings when teaching and learning activities, namely researchers do not manage time optimally and the state of students who are fasting makes them less focused when learning is in progress, because learning is carried out in the fasting month of Ramadan (Herowati & Barokah, 2023). As a result, the problems given are not resolved properly and are less active in asking. After identifying weaknesses in cycle I, researchers continued to improve cycle II to improve the quality of the teaching and learning process. Cycle II activities, the first meeting on Tuesday, April 4, 2023. The activities of students and educators are reassessed by the same observer. The following are the results of observations of cycle II activity in Table 7 below.

<table>
<thead>
<tr>
<th>No</th>
<th>Types of activities</th>
<th>Cycle II</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Student activities</td>
<td>Score 55, Percentage 80.88%, Category Good</td>
</tr>
<tr>
<td>2</td>
<td>Educator activity</td>
<td>Score 92, Percentage 88.46%, Category Good</td>
</tr>
</tbody>
</table>

In Table 7, the analysis results show that student activities obtained a score of 55 with a percentage of 80.88% in the good category. Meanwhile, educator activities obtained a score of 92 with a percentage of 88.46% in the good category. The next meeting is on April 6, 2023. Researchers provide a cycle II description test to know the magnitude of the increase in the ability of students when understanding mathematical concepts. The analysis data are shown in Table 6.
Table 8. Cycle II Description Test Results Score

<table>
<thead>
<tr>
<th>Number of learners</th>
<th>Complete</th>
<th>Unfinished</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>36</td>
<td>30</td>
<td>6</td>
<td>83.33%</td>
</tr>
</tbody>
</table>

Based on the results of the analysis of the cycle II description test in table 8 stated that of the 36 students who achieved completeness, 30 people with a percentage of 83.33%. This shows that most students have achieved KKM and have achieved the research target with a percentage of more than 80%. So, although the completeness of student learning is not perfect, it is true that with each cycle, students become better able to understand mathematical concepts and do their assignments.

Based on the Classroom Action Research carried out, it can be seen that learning using the ADDIE model assisted by the desmos application carried out in class X-D lasts for two cycles, affecting the improvement of students' ability to understand mathematical concepts in trigonometric material. (Rosita, 2019) By applying the addie learning model using handout media can achieve a level of completeness of learning outcomes. In research (Wijayanti, 2016) Also said that through the Addie learning model with the help of mind organizers increase student learning achievement. (Darsono et al., 2019) The ability of students when understanding mathematical concepts using mind mapping-assisted addie models is more effective than using models problem based learning. Research (Ulum et al., 2020) also stated learning outcomes with the ADDIE model are more effective. In addition to improving the ability to understand mathematical concepts, students are also more active in teaching and learning activities, thus affecting the activities of students and educators who also experience an increase when this ADDIE learning model is applied. In line with (Arini et al., 2013) states students are prepared to think critically, and logically when faced with unusual problems or situations when they are confronted with the ADDIE learning framework.

4. Conclusion

In this study, trigonometric material was studied in two cycles of class actions. It was shown that there was an increase in the mathematical understanding of learners influenced by the ADDIE model with the help of desmos applications used in both cycles. This is reflected in the increasing success of student and educator activities which result in the completeness of student learning. It is hoped that educators and other researchers who will research classroom actions can better understand how learners spend their time and find ways to make them more active in lessons. In addition, Classroom Action Research can be conducted over a longer period of time. This will allow the characterization of learners to be clearer and the learning process to achieve better results.

Bibliography


