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Development of E-Learning based on Discovery Learning Oriented to Problem-Solving Ability and Overcoming Math Anxiety

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Abstract

Problem-solving ability as one of the learning outcomes in the independent curriculum needs to be facilitated to achieve it. In addition, math anxiety which can affect problem-solving abilities needs to be addressed. Therefore, this research aims to produce and describe the feasibility of e-learning products based on discovery learning and oriented toward problem-solving ability and overcoming math anxiety in terms of validity, practicality, and effectiveness. This research is research and development using the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). The instruments used in this research consisted of validation sheets, teacher and student practicality sheets, learning implementation observation sheets, problem-solving ability tests, and math anxiety questionnaires. Validity and practicality data analysis was carried out using a quantitative data conversion table to qualitative data in the form of standard values. Effectiveness analysis was carried out using the paired sample t-test, Wilcoxon signed rank test and proportion test. The validity test meets valid criteria both in terms of material and media. The practicality test based on teacher and student assessments is very practical and on the feasibility of learning activities is very practical. The effectiveness test shows differences in problem-solving ability and math anxiety in the pre-test and post-test. The proportion test shows classical completeness in problem-solving ability and math anxiety so that it meets the effective criteria. The product was developed to facilitate problem-solving abilities and overcome math anxiety in the form of e-learning based on discovery learning on congruency and congruence material meets the feasibility criteria in terms of validity, practicality, and effectiveness.

Keywords: *Discovery Learning; E-Learning; Problem-Solving Ability; Math Anxiety*

Introduction

Learning mathematics is one of the subjects taught in formal education from elementary to tertiary education. This shows that mathematics is important in life. Decree of the Head of the Educational Standards, Curriculum and Assessment Agency (2022) Number 33/H/KR/2022 concerning learning outcomes states that one of the objectives of mathematics subjects is mathematical problem-solving which includes the ability to understand problems, design mathematical models, complete models or interpret the solution obtained. Problem-solving is also an important part of everyday life because of its practical role for individuals and society (Culaste & Culaste-Quimbo, 2011). Peranginangin et al.

(2019) said that problem-solving is a very important part of the standard mathematics process because in the learning and solving process, students use abilities and experiences that must be applied in solving non-routine problems. Students with good problem-solving ability also find it easier to develop their metacognition in learning because students have to apply their knowledge to solve complex problems (Ma et al., 2017). Akben (2020) revealed that it is important to improve problem-solving abilities in learning because it affects abilities in everyday life. This was emphasized by Maulyda (2020) explaining that problem-solving abilities need to continue to be sharpened and improved.

However, many students face difficulties in understanding and applying mathematical concepts, especially in problem-solving (Jatmiko, 2018). At the solution planning stage, students have not written down strategies correctly because they have not understood the material well (Yuwono et al., 2018), students have not understood the problem (Rahmmatiya & Miatun, 2020), and students have not been able to formulate strategies correctly (Purnamasari & Setiawan, 2019). Several factors that influence students' low problem-solving in mathematics learning are the learning atmosphere, learning strategies, learning methods. These factors need to be considered so that students do not feel pressured or experience excessive anxiety about mathematics (Riski et al., 2019) because math anxiety has a negative effect on problem-solving abilities.

Several studies show the negative influence of math anxiety on problem-solving abilities. Riski et al. (2019) shows that math anxiety has a negative effect on problem-solving ability by 31.9%, according to Lutfiyah et al. (2019) 42,9%, according to Ratna and Yahya (2022) 15,4%. S Students with high math anxiety experience errors in writing mathematical symbols, interpreting mathematical models, and inconsistencies in using symbols (Irfan, 2017).

Luttenberger et al. (2018) shows that there is always a negative relationship between math anxiety and mathematics learning achievement in students from grades 6-12. This certainly needs to be considered in the learning process. To support problem-solving abilities and create comfortable learning activities, teachers can apply learning models and utilize technology in the learning process. One learning model that can be applied is discovery learning. Discovery learning provides opportunities for students to discover concepts for themselves (Hammer, 1997) so that they have a sense of ownership of that knowledge (Brown, 1992). Several studies also show the effect of discovery learning on students' problem-solving ability, such as Hariyanto et al. (2023); Purwaningsih et al. (2020); Simamora et al. (2019); Windiyani et al. (2023). Several studies show that the discovery learning model can improve students' problem-solving ability.

Apart from that, technology is present as a necessity that makes all the activities of today's modern society easier (Rahmawati et al., 2021). The use of technology, especially the internet, also increases every year among Indonesians aged 5 years and over. However, the benefits of the internet are not widely used in education, only 33.04% of the population aged 5 years and over access the internet with the aim of getting information for learning purposes (BPS Indonesia, 2022). Seeing the increase in the percentage of internet users, on the other hand the use of the internet for learning purposes is still low, society, especially students, needs to get used to using the internet for learning.

Technology in education is used to provide easier and more effective learning in relation to the audience and interests and characteristics of students at the right time effectively, in accordance with needs and changes and developments in the education system (Ahmadigol, 2016). One of the digital technologies for learning that continues to develop is e-learning. E-learning allows students to access learning materials flexibly and independently via electronic devices, such as computers, tablets or cellphones (Sum & Oancea, 2022). With the help of technology, e-learning can be done using the internet via technological devices which can be done anywhere (Cole et al., 2020) making it easier to access learning (Baby & Kannammal, 2020).

There are various e-learning that can be used in learning mathematics. Nearpod (nearpod.com) is

an e-learning platform that allows teachers to create and deliver interactive learning materials to students. Interactive learning is demonstrated by student participation in the learning process (Smith, 2006). By using e-learning, teachers can combine multimedia elements, such as presentations, videos, images, and quizzes, which make learning more interesting and interactive. Several previous studies have used Nearpod in mathematics learning, such as Risky et al. (2023) who used e-learning to improve students' mathematical abilities and motivation, Oktafiani and Mujazi (2022) showed that there was a positive influence of using e-learning on the motivation of grade 5 students, Widiawati et al. (2022) shows that the use of E-learning is effective in improving students' problem-solving ability. Therefore, E-learning can support a good learning process to achieve learning goals.

In learning mathematics, geometry is one aspect that is often tested. This data shows that the percentage of students from 2015 to 2019 is still low with the highest achievement being only 52.08%. Apart from that, especially in determining the angle of a triangle, it is also still low. This is shown by the percentage of the 2019 National Examination (UN) scores in calculating the angles of triangles in variable form of 47.11%, calculating the length of certain elements in congruence of 20.40%, solving problems in congruence of 45.39% (Pusat Penilaian Pendidikan, 2019).

Therefore, e-learning based on discovery learning on geometry material can be used to support problem-solving abilities and create a comfortable learning atmosphere so that students' math anxiety can decrease.

Method

The research carried out is both research and development or Research and Development (R&D) with the ADDIE model from Dick and Carrey, which is formed from five stages, namely Analysis, Design, Development, Implementation, and Evaluation (Gagne et al., 2005).

Data was collected using test and non-test instruments. The test instrument is in the form of problem-solving ability questions on congruence and similarity material which are prepared based on learning outcomes and indicators of problem-solving ability. Non-test instruments are in the form of instrument assessment questionnaires filled in by validators, media assessment questionnaires filled in by validators, teachers and students and observation sheets filled in by observers during the learning process. The following are data collection techniques and instruments.

Product validity assessment score data by media and material experts is calculated using average scores and categorized based on the following table.

Table 1. Categories Based on Product Assessment Score Intervals

Score Intervals	Categories
$4{,}20 \leq x \leq 5{,}00$	Very good
$3{,}40 < x \leq 4{,}20$	Good
$2{,}60 < x \leq 3{,}40$	Enough
$1{,}80 < x \leq 2{,}60$	Not enough
$1{,}00 \leq x \leq 1{,}80$	Very less

Source: Widoyoko (2017)

Product practicality data was obtained from the learning implementation observation sheet, teacher assessment sheet, and student assessment sheet regarding the product. The percentage ranges and categories are as follows.

Tabel 2. Percentages and Qualitative Criteria

Range	Categories	Criteria
85,01% - 100,00%	Very practical	Can be used without repair
70,01% - 85,00%	Practical	Can be used with minor revisions
60,01 – 70,00%	Fairly practical	Can be used with considerable improvements
50,01 – 60,00%	Less practical	Can be used with major improvements
01,00% - 50,00%	Not practical	Can not be used

Source: Akbar modification (2013)

The e-learning being developed is said to be practical if the teacher and student assessments meet the minimum category of "Fairly Practical". Product practicality based on the percentage of implementation of learning activities refers to the following criteria.

Table 3. Learning Implementation Criteria

Score Range	Criteria
$90\% \leq p \leq 100\%$	Very good
$80\% \leq p < 90\%$	Good
$70\% \leq p < 80\%$	Enough
$0\% \leq p < 60\%$	Less

Source: Sudjana (2010)

The results of observations of learning implementation meet practical criteria if the percentage of learning implementation reaches a minimum of the "Good" category.

Data analysis to determine the quality of e-learning effectiveness was carried out by analyzing test scores on students' problem-solving abilities and math anxiety in mathematics learning. The use of e-learning for problem-solving ability is said to be effective if the average problem-solving ability test reaches the Learning Goal Achievement Criteria (KKTP) set by the school, namely 75 and the percentage of students who get a score above the KKTP reaches 75%. Categories of students' problem-solving ability are presented as follows.

Table 4. Categories of Problem-Solving Ability

Value Intervals	Categories
$92 < x \leq 100$	Very high
$83 < x \leq 92$	High
$75 \leq x \leq 83$	Medium
$x < 75$	Low

Source: Tim Direktorat Pembinaan SMP (2017)

The use of e-learning for math anxiety is said to be effective if the average score of students' math anxiety questionnaire results is in the low anxiety category (minimum score of 85) with a percentage reaching 75%. The following are categories of math anxiety.

Table 5. Categories of Math Anxiety

Score Intervals	Score	Categories
$M_i + 1{,}5Sd_i < x \leq M_i + 3Sd_i$	$108 < x \leq 144$	Very low
$M_i + 0{,}5Sd_i < x \leq M_i + 1{,}5Sd_i$	$84 < x \leq 108$	Low
$M_i - 0{,}5Sd_i < x \leq M_i + 0{,}5Sd_i$	$60 < x \leq 84$	Currently
$M_i - 1{,}5Sd_i < x \leq M_i - 0{,}5Sd_i$	$36 < x \leq 60$	High
$M_i - 3Sd_i < x \leq M_i - 1{,}5Sd_i$	$0 < x \leq 36$	Very high

Source: Ebel & Frisbie modification (1991)

Information:

$M_i : \frac{1}{2}$ (Ideal maximum score + ideal minimum score)

$Sd_i : \frac{1}{6}$ (Ideal maximum score + ideal minimum score)

Analysis was carried out using the paired sample t-test if the data was normally distributed (Walpole et al., 2012) and the Wilcoxon signed rank test if the normality assumption was not met (Herrhyanto & Gantini, 2021). To determine whether classical completion has been achieved, a proportion test is carried out.

Results and Discussion

Results

The product developed is oriented towards problem-solving ability and overcoming students' math anxiety. Discovery learning-based e-learning products were developed according to the stages in the development of the ADDIE model (Analyze, Design, Development, Implement, and Evaluate). The detailed research results are as follows.

Analysis Stage

This stage is carried out by analysing student needs, curriculum and characteristics. Needs analysis was carried out by providing observation sheets to teachers and students at Sungguminasa State Junior High School 4 which were collected via gform. Filling in the observation sheet was carried out by one of the teachers who taught in class VIII and 31 class VIII students. Filling in the observation sheet is followed by an interview with the teacher to find out the problems and needs in depth. The needs analysis carried out shows that: (1) the media used are usually teaching aids, e-learning has not been used in offline learning, (2) As many as 51.6% of students are aware of the anxiety experienced during learning, (3) As many as 83.9% % of students have internet access but teachers have not provided e-learning, (4) As many as 93.5% of students expect the learning process in class to use e-learning, (5) As many as 90.3% of students feel that e-learning can help in understanding mathematics material.

Curriculum analysis was carried out by interviewing mathematics teachers. The results of the interviews showed that the curriculum used at State Junior High School 4 Sungguminasawas the Merdeka curriculum so that studies were carried out related to learning outcomes, learning objectives, flow of learning objectives and teaching modules. Each phase has a certain class range and class VIII is in phase D.

Analysis of student characteristics is carried out to adapt the product being developed. Class VIII

students are in the 13-14 years age range and were born in 2010-2011. Children born in 2010-2011 are generation Z and generation Alpha who are familiar with technology and are used to using smartphones. However, students' use of smartphones is not widely used in the learning process. In fact, smartphones can be used to access various learning materials in various forms, whether in the form of video, text, audio, audio visual and games. The use of technology also provides space for teachers to present material to support students' abilities. The product developed is e-learning based on discovery learning which supports problem-solving ability and overcomes students' math anxiety.

Design Stage

The design stage is carried out by designing an e-learning design based on the analysis carried out in the previous stage. E-learning is designed based on Learning Outcomes (CP), Learning Objectives (TP), and teaching modules. Learning Outcomes (CP) used in this research refer to the Decree of the Head of the Educational Standards, Curriculum and Assessment Agency Number 033/H/KR/2022, especially in mathematics subjects phase D, geometric elements, congruence and similarity, namely that students can explain the properties congruence and similarity in triangles and quadrilaterals and use them to solve problems. Based on these learning achievements, learning objectives are then formulated.

The teaching module is presented in detail including the syntax of the learning model used. The learning model is determined by considering the curriculum used. The Merdeka Curriculum emphasizes learning that focuses on students so that the discovery learning model is chosen which is designed so that students can solve problems on the concepts of similarity and congruence. Therefore, the e-learning developed is based on discovery learning. There are six syntaxes in the discovery learning model, namely (1) stimulus is done by providing a video/image as a trigger for the material to be studied, (2) problem statement which is facilitated by questions on the video or based on the image , (3) data collection is facilitated by video and open-ended questions, (4) data processing is facilitated by asking questions via interactive video, (5) verification is carried out by embedding a STUDENTS WORKSHEETS link that is connected to live worksheet, and (6) generalization is carried out by presenting conclusions and giving an independent quiz using time to climb. The syntax of the learning model, the flow of problem-solving, and students' mathematical anxiety are the main aspects in product development.

Development Stage

The development stage is carried out by creating e-learning based on plans at the design stage and based on expert advice. The development stage is carried out by preparing text, videos, materials, and expert validation. E-learning development is carried out by utilizing the features available on nearpod, such as open-ended questions, memory tests, and others. The e-learning design refers to the discovery learning model and is oriented towards problem-solving ability and overcoming students' math anxiety.

The validity of the e-learning developed was assessed by media experts and material experts. Media experts assess the validity of e-learning based on content quality, ease of navigation, motivation, design overview, user interaction and usability. Meanwhile, material experts assess the validity of e-learning based on the quality of the content and objectives and use of language. The results of the e-learning assessment by media experts and material experts are presented in the following table.

Table 6. Recapitulation of E-learning Assessment by Experts

Expert	Average Score	Validity Categories
Media	4,06	Good
Material	4,37	Very good

Based on these results, it was concluded that the feasibility of the e-learning being

developed, both from the material and media aspects, showed validity that met the criteria for use in the learning process. The e-learning is revised first according to input from experts, before it can then be used in trials.

Implementation Stage

The implementation stage is carried out to determine the effectiveness of using the e-learning that has been developed. Implementation was carried out with small scale trials and then large-scale trials. Small-scale trials were carried out on teachers and students by filling in a practicality sheet to measure the practicality of e-learning. The practicality test was carried out involving 17 students and a teacher. The teacher and students check the e-learning that has been prepared from the first meeting to the last learning meeting. The following is a summary of the results of the e-learning assessment by the teacher.

Tabel 7. E-Learning Assessment Results by Teachers

Assessment Aspects	Assessment Score
Ease of use	4,50
Content quality	4,63
Attractiveness	4,33
Total	13,46

The following are the calculation results after making substitutions in the formula.

$$V_{au} = \frac{13,46}{15} \times 100\% = 89,72\%$$

User validation of 89.72% is in the very practical category so that the e-learning developed is suitable for use based on the practical aspect. The following is a summary of the results of e-learning assessments by students.

Table 8. Results of E-learning Assessment by Students

Assessment Aspects	Assessment Score
Ease of use	4,50
Content quality	4,47
Attractiveness	4,55
Total	13,53

Following are the calculation results using the formula.

$$V_{au} = \frac{13,53}{15,00} \times 100\% = 90,17\%$$

User validation of 90.17% is in the very practical category so that the e-learning developed is suitable for use based on the practical aspect. Products and instruments that are valid and practical are implemented in large-scale learning that takes place in the classroom. The learning implementation begins with a pre-test, then the learning process lasts for 4 meetings and ends with a post-test.

Evaluation stage

The evaluation stage is carried out to assess the feasibility of the product being developed. The feasibility of e-learning based on discovery learning which is oriented towards problem-solving ability

and overcoming students' mathematical anxiety is seen from the aspects of validity, practicality and effectiveness. The validity test has been discussed at the development stage so that at this stage a practicality test and an effectiveness test are presented.

To determine the practicality of the e-learning being developed, tests were carried out on the data that had been collected, namely teacher and student assessments of e-learning and observation sheets on learning implementation. The following are the results of the analysis of learning implementation.

Table 9. Results of Learning Implementation Analysis

Meeting	Teacher Activities			Student Activities		
	Score	Percentage	Criteria	Score	Percentage	Criteria
1	19	86,36%	Good	19	86,36%	Good
2	21	95,45%	Very good	21	95,45%	Very good
3	20	90,91%	Very good	20	90,91%	Very good
4	19	86,36%	Good	19	86,36%	Good
Total	79	89,77%	Good	79	89,77%	Good

Table 10. Total Learning Implementation Assessment

Total Teacher Activities	Total Student Activities	Total	Percentage	Criteria
79	79	158	89,77	Good

Based on the results of the learning implementation analysis in table 4 and table 5, the total assessment of learning implementation was 158 with a percentage of 89.77. This percentage meets the "Good" criteria so that the quality of e-learning based on observations of learning implementation can be said to be practical.

The effectiveness of e-learning based on discovery learning which is oriented towards problem-solving ability and overcoming students' math anxiety is determined by analyzing data from tests of mathematics problem-solving ability and the results of students' math anxiety questionnaires. Before testing the hypothesis, a normality test is carried out. The results of the univariate normality test are presented in the following table.

Table 11. Normality Test Results

Data	*sig.*	Decision
Pre-test problem-solving ability	0,001	Not normal
Post-test problem-solving ability	0,035	Not normal
Pre-test math anxiety	0,093	Normal
Post-test math anxiety	0,200	Normal

Based on the normality test, math anxiety data was analyzed using the paired sample t-test and problem-solving ability data using the Wilcoxon signed rank test. The following are the results of the paired sample t-test.

Tabel 12. Paired Sample t-Test Results

Data	t_{count}	*Sig.*	Decision
Math Anxiety	5,679	0,0001	H_0 rejected

The significance value of 0.0001 is smaller than α (0.05), so it can be concluded that there is a difference in students' math anxiety before and after the learning process. The Wilcoxon signed rank test was carried out to test the differences in data before and after learning on problem-solving ability. Following are the results of the Wilcoxon signed rank test.

Tabel 13. Hasil Uji Rank Wilcoxon

Data	Average Increase	*Sig.*	Decision
Problem-solving ability	14,50	0,0001	H_0 rejected

The significance value of 0.0001 is smaller than α (0.05) so it can be concluded that there is a difference in students' problem-solving ability before and after the learning process. The proportion test is carried out to determine whether classical completion has been achieved. Following are the results of the proportion test.

Table 14. Proportion Test Results

Data	sig	Decision
Problem-solving ability	0,138	H_0 rejected
Math anxiety	0,068	H_0 rejected

The table shows that the significance value for problem-solving is 0.135 and the significance for math anxiety is 0.068, so that the classical completeness of students' problem-solving ability and math anxiety is achieved.

Discussion

The development carried out resulted in e-learning on congruency and congruence material which was oriented towards students' problem-solving ability and mathematical anxiety. Based on the results of expert validation and trials that have been carried out, it can be concluded that the e-learning developed in this research has met the criteria of being valid, practical, and effective.

E-learning products are developed using nearpod which can be accessed via the link https://nearpod.com/. Teachers need to log in while students can log in using the access code given by the teacher. Apart from this link, nearpod can be accessed via an application that can be downloaded from the Play Store. Applications developed with nearpod are designed based on discovery learning syntax to facilitate problem-solving ability and overcome math anxiety. The syntax of discovery learning is stimulus, problem identification, data collection, data processing, proof, and generalization. The problem-solving ability indicators used are understanding the problem, planning action, implementing the plan, and evaluating the results. Meanwhile, math anxiety is seen through student interaction with the material, student interaction with the teacher, the learning process, and tests/exams on cognitive, affective, and physiological aspects.

The e-learning developed utilizes tools on the nearpod so that it can fulfil the syntax of discovery learning while facilitating problem-solving ability and overcoming students' math anxiety. The e-learning developed facilitates indicators of problem-solving ability, namely understanding problems, planning actions, implementing plans, and evaluating results and overcoming math anxiety in cognitive, affective and physiological aspects.

The first step, namely providing a stimulus, is carried out using a memory test or using pictures that direct students to the material to be studied. Providing stimulus encourages students' ability to understand problems as an initial stage in problem-solving. Providing stimulus can be done by showing

pictures for students to observe or providing simple games that direct the material to be studied. On the e-learning you can use a memory test or add images/videos as a stimulus. In the memory test students are asked to pair the same pictures and, in the pictures, students are asked to pay attention to the pictures so they can answer the questions given. Providing pictures/videos or simple games that make it easier for students to observe problems encourages students to believe in their abilities. The following is the provision of stimulus in discovery learning.

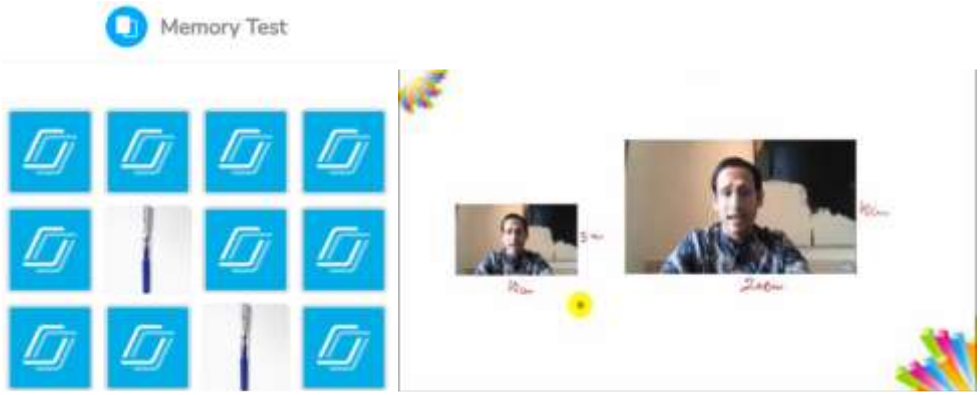


Figure 1. Example Providing Stimulus in Discovery Learning

Next, problem statement is carried out by asking students questions based on the stimulus that has been given. Giving questions gradually in solving problems can encourage students to plan actions and can help students to focus on learning (cognitive aspects of math anxiety). The following is an example of problem identification provided using the tools in discovery learning.

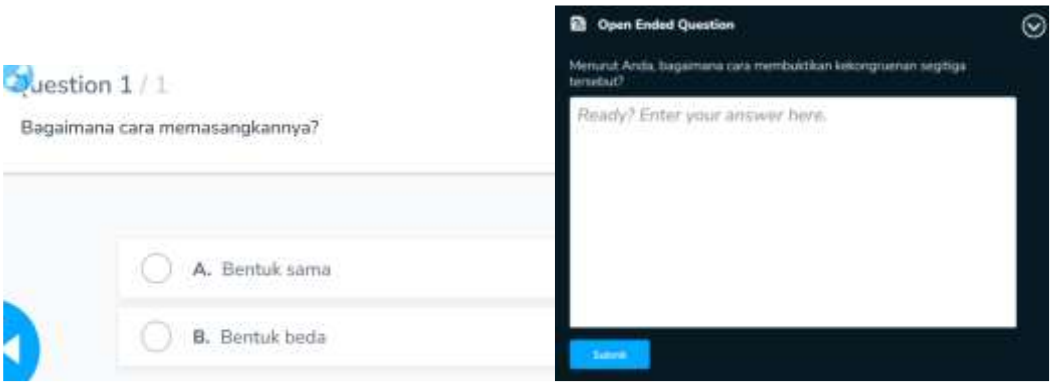


Figure 2. Example of a Problem Statement in Discovery Learning

Next, data collecting is carried out by presenting pictures to students to observe or/and asking students questions using open ended questions. Giving open ended questions guides students to think about ways to solve problems and gives students the opportunity to answer according to their ideas so that students can plan actions. This can also make students not feel hesitant/afraid in giving answers (affective aspect of math anxiety). The following is an example of data collection in discovery learning.

Figure 4. Example of Data Collecting in Discovery Learning

Next is data processing, which is done by asking students questions that guide students to solve problems. These questions are presented in an interactive video. The action planning stage in the previous stage can help students carry out plans at this stage so that students are no longer given stimulus or direction in solving the problem. In addition, students' mathematical anxiety in the cognitive and affective aspects can be overcome because at this stage, students can provide answers according to their experience in planning actions at the previous stage. The following is an example of data processing in discovery learning.

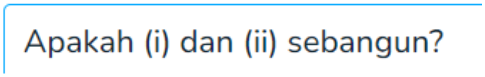


Figure 5. Example of Data Processing in Discovery Learning

Next, verification is carried out by giving students worksheets that have been connected to the live worksheet. The students' worksheets link is embedded in the nearpod so that students can access it via the link. Work on students' worksheets is done in pairs so that students can discuss and help each other in solving problems. The following is an example of verification in Discovery Learning.

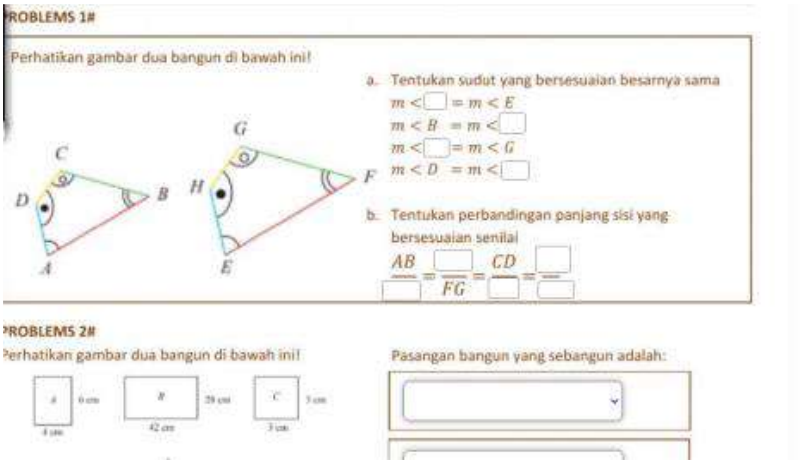


Figure 6. Example of Verification in Discovery Learning

Next, generalization is carried out by presenting conclusions and taking quizzes independently using time to climb. The following is an example of how it is presented in discovery learning.

Figure 7. Example of Generalization in Discovery Learning

Every question answered by students on the Nearpod is stored on the Nearpod and can be accessed by the teacher, making it easier for teachers to provide process assessments to students.

Apart from paying attention to discovery learning syntax, the e-learning being developed is also oriented towards problem-solving ability and overcoming students' math anxiety. Problem-solving ability consisting of four indicators are packaged in the e-learning being developed. Likewise, students' math anxiety is also packaged in such a way that students can participate in the learning process optimally.

Students' problem-solving ability are divided into four categories, namely very high, high, medium and low. The following is the distribution of problem-solving ability categories.

Table 15. Distribution of Problem-Solving Ability Categories

Value Intervals	Categories	Frequency	Percentage
$92 < x \leq 100$	Very high	11	39,29%
$83 < x \leq 92$	High	5	17,86%
$75 \leq x \leq 83$	Medium	2	7,14%
$x < 75$	Low	10	35,71%
Total		28	100%

Based on the KKTP score of 75 and table 15, 18 students who achieved the KKTP were in the medium, high, and very high categories. There were 11 students with a percentage of 39.29% in the very high category, 5 students with a percentage of 17.86%, and 2 students with a percentage of 7.14%. Meanwhile, there were 10 students who did not achieve the KKTP score with a percentage of 35.71%. This is influenced by students' answers in completing problem-solving on the four questions that have been provided. The following are details of the post-test results for problem-solving ability.

Table 16. Post-Test Results for Problem-Solving Ability

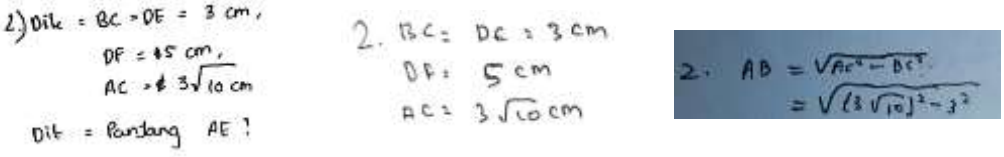
Indicator	Question Items	Indicator Achievement		Average Indicator	Achievement
		Percentage	Category	Percentage	Category
Understanding the problem	1	88,10%	High	72,62%	Low
	2	63,10%	Low		
	3	66,67%	Low		
	4	72,62%	Low		

Planning action	1	83,33%	High	88,89%	High
	2	96,43%	Very high		
	3	89,29%	High		
	4	88,10%	High		
Implementing the plan	1	75,00%	Medium	83,33%	High
	2	80,95%	Medium		
	3	89,29%	High		
	4	88,10%	High		
Evaluating results	1	75,00%	Medium	67,86%	Low
	2	64,29%	Low		
	3	64,29%	Low		
	4	67,86%	Low		

Table 17. Percentage of Achievement Based on Score Distribution

Indicator	Score Distribution		
	Maximum Score	Not Maximum	No answer
Understanding the problem	66,96%	8,93%	24,11%
Planning action	76,79%	21,43%	1,79%
Implementing the plan	59,82%	39,29%	0,89%
Evaluating results	67,86%	0,00%	32,14%

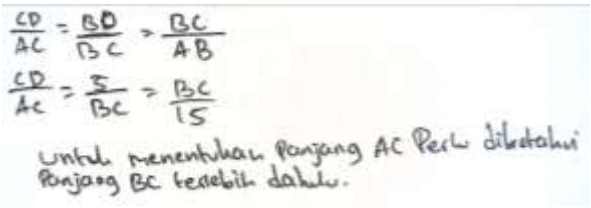
The problem-solving process is divided into four stages, namely understanding the problem, planning action, implementing the plan, and evaluating the results. At the stage of understanding the problem, 72.62% was achieved in the low category. Of the four questions, only question number one reached the high category with a percentage of 88.10%, the other three questions were in the low category. This could be because some students did not write down the complete information presented in the questions and some others did not write it down at all. In question number one of the understanding the problem stage, there were three students who did not write any information at all, one student wrote information but incompletely and 24 other students wrote it completely. In question number two there were ten students who did not write the information, one student wrote the information, but it was incomplete, and 17 students wrote the information completely. In question number three, eight did not write information, four students wrote information, but it was incomplete, and 16 students wrote information completely. In question number four, six students did not write the information, four students wrote the information, but it was incomplete, and 18 students wrote the information completely. This can be caused by various factors, such as the information being presented clearly in the picture in the question so that students do not rewrite the information, or the information written down is sometimes incomplete. Students who do not get the maximum score in the low category are students who do not achieve the KKTP score. The following is an example of a student's answer at the understanding the problem stage.



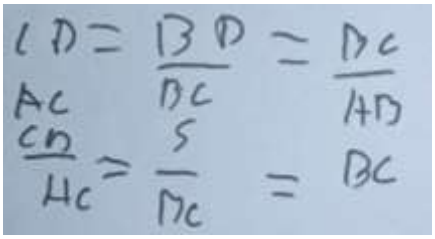
(a) Maximum score (b) Not maximum (c) Not answer

Figure 8. Examples of student answers at the Understanding the Problem Stage

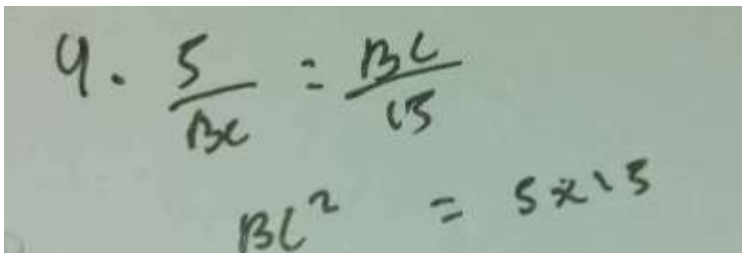
At the action planning stage, some students were able to do it well as shown by students being able to make plans by representing the problem using the right formula and writing the formula correctly. The percentage of achievement of action planning indicators was 88.89% in the high category. Several other students did not write complete/incomplete action plans with a percentage of 21.43%. However, in questions number three and number four there was one student who did not write an action plan. These two students are students with low problem-solving ability categories. The following is an example of a student's answer.



(a) Maximum score



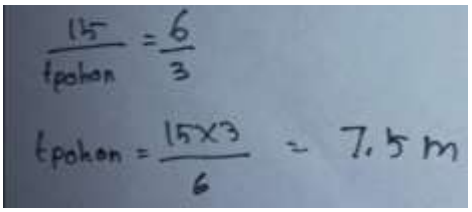
(b) Not maximum



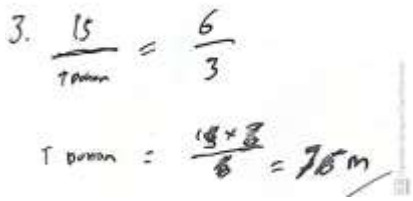
(c) Not answer

Figure 9. Example of student answers at the action planning stage

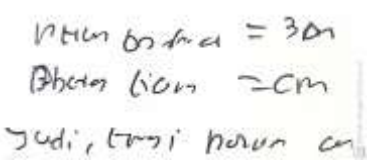
At the stage of implementing the plan, some students were able to solve problems according to the plan that had been prepared so that the indicator achievement reached 83.33%. This percentage is quite high because 59.82% of students carried out the plan correctly so they got the maximum score and 39.29% of students did not get the maximum score. Most students make mistakes in calculations, not in the process of using formulas and solving problems. The following is an example of a student's answer.



(a) Maximum score



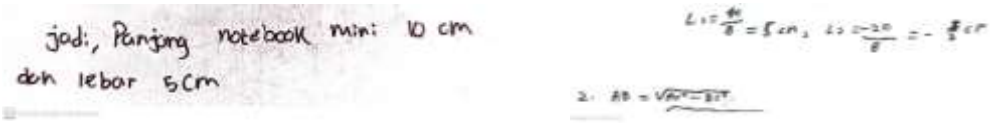
(b) Not maximum



(c) Not answer

Figure 10. Example of Student Answers at the Implementing Plan Stage

At the stage of evaluating the results, some students had written the final answers to the results obtained previously with an indicator achievement percentage of 67.86%. However, there are still students who do not write result evaluations with a percentage of 32.14%. The following is an example of a student's answer.



(a) Maximum score (b) Not maximum

Figure 11. Example of Student Answers at the Evaluating Results Stage

The learning process that takes place using e-learning has a good impact on students' abilities. Several previous studies have demonstrated the use of e-learning in mathematics learning, such as Valencia-Vallejo et al. (2019) (Wangid et al., 2021), Vanbecelaere et al. (2021), Yang et al. (2022), Ahmad and Junaini (2022). This shows that e-learning has the potential to improve students' problem-solving ability.

Math anxiety is divided into five categories which indicate the level of students' math anxiety. The higher the math anxiety score, the lower the student's math anxiety. The following is the distribution of students' math anxiety categories.

Table 18. Distribution of Students' Math Anxiety Categories

Score Intervals	Categories	Frequency	Percentage
$108 < x \leq 144$	Very low	2	7,14%
$84 < x \leq 108$	Low	15	53,57%
$60 < x \leq 84$	Medium	11	39,29%
$36 < x \leq 60$	High	0	0,00%
$0 < x \leq 36$	Very high	0	0,00%
Total		28	100%

Table 19. Percentage Distribution Based on Aspects and Sources of Math Anxiety

Sources	Aspects			Average
	Cognitive	Affective	Physiological	
Interaction with materials	67,50%	60,00%	78,93%	68,81%
Interaction with teacher	74,29%	70,36%	86,07%	76,90%
Learning process	72,86%	78,21%	77,14%	76,07%
Test/exam	67,50%	67,50%	78,57%	71,19%
Average	70,54%	69,02%	80,18%	73,24%

Based on table 18 and table 19, descriptively there were 11 students with a percentage of 39.29% who did not meet the effective criteria score because they did not reach the low category. Math anxiety is measured by three aspects, namely cognitive aspects, affective aspects, and physiological aspects. The cognitive aspect reached a percentage of 70.54%, the affective aspect 69.02%, and the physiological aspect 80.18%. Apart from that, the measured math anxiety originates from four things, namely interaction with mathematics material reaching 68.81%, originating from interaction with teachers

reaching 76.90%, originating from the mathematics learning process at 76.07%, and originating from mathematics tests. 71.19%. Students' math anxiety reached 73.24%, this supports the proven hypothesis that e-learning can overcome students' math anxiety.

Implication of Research

The development product in the form of e-learning based on discovery learning can be used as a trigger to continue developing technology-based learning media in mathematics learning. This needs to continue to be encouraged to support the independent curriculum education program.

Conflict of Interest

There is no conflict of interest.

Limitation

The students' internet network was inadequate so at the next meeting the researchers used a mobile hotspot. Apart from that, the capacity of students' smartphones is not sufficient to operate nearpod so some students need to delete other applications first during learning. In the learning process at the first meeting there were technical obstacles in using the projector, so it took up a little time. The next meeting, the projector is prepared before learning begins.

Conclusion

The practical product of this research is e-learning based on discovery learning which has several characteristics, namely (1) Facilitating students' problem-solving ability which are packaged in discovery learning steps. (2) Overcoming students' math anxiety by utilizing the features on nearpod. (3) Using interactive quiz and video features and other features so that they are interactive, easy, and fun. The development product, namely e-learning based on discovery learning, is quality when viewed from a validity perspective. The average product validity assessment scores are 4.06 and 4.37, so the product is said to be valid both in terms of material and media. The development product in the form of e-learning based on discovery learning is of high quality when viewed from a practical perspective. The teacher obtained a practicality percentage of 89.72%, meaning the product is very practical. Meanwhile, students obtained a practicality percentage of 90.17%, meaning the product was categorized as very practical. Apart from that, the level of implementation of learning activities is good with a percentage of 89.77%. The level of implementation of this learning is categorized as very practical. The development product in the form of e-learning based on discovery learning is of high quality when viewed from an effectiveness perspective. Hypothesis testing shows that there is a difference in the average pre-test and post-test scores on students' problem-solving ability and math anxiety. The proportion test shows that classical completeness in problem-solving ability and mathematical anxiety is achieved.

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