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DEVELOPMENT OF MATHEMATICS LEARNING MODULES BASED ON CREATIVE PROBLEM-SOLVING ON TRIGONOMETRY MATERIAL

Fitriani Nur[1)*], Masita[2)]
[1,2]Universitas Islam Negeri Alauddin Makassar
[1,2]Jalan H. M. Yasin Limpo No.36, Romangpolong, Gowa, Indonesia
Email: fitrianinur@uin-alauddin.ac.id[1)*], 20700117017@uin-alauddin.ac.id[2)]

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Abstract:
The development of effective and innovative mathematics learning modules is an important effort to improve the quality of the learning process, especially in materials that require concept understanding and creative thinking skills, such as trigonometry. One model that can be used to achieve this goal is creative problem solving (CPS), which invites students to find innovative and effective solutions to complex mathematical problems. This study aims to develop a math learning module based on creative problem-solving on trigonometry material that is valid, practical, and effective. The module development was conducted using the ADDIE model which consists of five stages, namely analysis, design, development, implementation, and evaluation. The test subjects involved students of SMAN 21 Gowa. The research instruments were module validation sheets, educator and learner response questionnaires, observation sheets, and learner learning outcomes tests. The research data analysis focused on analyzing the validity, practicality, and effectiveness of the creative problem-solving-based mathematics learning module on trigonometry material. The results showed that the creative problem-solving-based math learning module on trigonometry material had met the criteria of validity, practicality, and effectiveness. Thus, this learning module is suitable for use in the implementation of mathematics learning, especially in trigonometry material.

Keywords: Creative Problem Solving, Learning Module, Trigonometry

PENGEMBANGAN MODUL PEMBELAJARAN MATEMATIKA BERBASIS CREATIVE PROBLEM-SOLVING PADA MATERI TRIGONOMETRI

Abstrak:
Pengembangan modul pembelajaran matematika yang efektif dan inovatif merupakan upaya penting untuk meningkatkan kualitas proses pembelajaran, khususnya dalam materi yang menuntut pemahaman konsep serta keterampilan berpikir kreatif, seperti trigonometri. Salah satu model yang dapat digunakan untuk mencapai tujuan ini adalah creative problem solving (CPS), yang mengajak peserta didik untuk menemukan solusi inovatif dan efektif terhadap masalah-masalah matematika yang kompleks. Penelitian ini bertujuan untuk mengembangkan modul pembelajaran matematika berbasis creative problem solving pada materi

Trigonometri yang valid, praktis, dan efektif. Pengembangan modul dilakukan dengan menggunakan model ADDIE yang terdiri dari lima tahapan, yaitu analisis, desain, pengembangan, implementasi, dan evaluasi. Subjek uji coba melibatkan siswa SMAN 21 Gowa. Instrumen penelitian berupa lembar validasi modul, kuisioner respon pendidik dan peserta didik, lembar observasi, serta tes hasil belajar peserta didik. Analisis data penelitian difokuskan pada analisis kevalidan, kepraktisan, dan keefektifan modul pembelajaran matematika berbasis creative problem-solving pada materi trigonometri. Hasil penelitian menunjukkan bahwa modul pembelajaran matematika berbasis creative problem solving pada materi trigonometri telah memenuhi kriteria kevalidan, kepraktisan, dan keefektifan. Dengan demikian, modul pembelajaran ini layak digunakan dalam pelaksanaan pembelajaran matematika, khusunya pada materi trigonometri.

Kata Kunci: Creative Problem-Solving, Modul Pembelajaran, Trigonometri

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INTRODUCTION

Mathematics is a science that is part of human life that discusses facts and relationships as well as forms and spaces (Nur'aini, Harahap, Badruzzaman, & Darmawan, 2017). The knowledge gained from mathematics education can be used as a source of problem-solving when facing problems related to numbers. Mathematics is used as a source of knowledge to educate students to have skills in logical, creative, and systematic thinking. In solving mathematical problems, students' skills are needed in interpreting problems into mathematical models, numeracy skills, mastery of concepts, and others (Ardi & Saripudin, 2020). So problems that arise in working on mathematical problems, especially in trigonometric learning, can be minimized and can develop students' ability to work on problems through these skills.

Trigonometry is one of the materials in mathematics learning that must be mastered by students as a supporting science in other learning such as physics (Rachman & Amelia, 2020). Kariadinata said that trigonometry is a branch of mathematics that discusses the angle of triangles and the function of trigonometry (Subroto & Sholihah, 2018). In the Qur'an itself, it is explained

how trigonometric learning is useful in daily life, precisely in QS. Al-Baqarah/2:149 which reads:

وَمِنْ حَيْثُ خَرَجْتَ فَوَلِّ وَجْهَكَ شَطْرَ ٱلْمَسْجِدِ ٱلْحَرَامِ ۖ وَإِنَّهُۥ لَلْحَقُّ مِن
رَّبِّكَ ۗ وَمَا ٱللَّهُ بِغَٰفِلٍ عَمَّا تَعْمَلُونَ ﴿١٤٩﴾

Translation:
"And wherever you come out, then turn your face towards the Grand Mosque, indeed that provision is something that is the right of your Lord. And Allah is never careless from what you do" (Departemen Agama RI, 2007).

This verse explains the importance of the correct direction of the qibla in performing prayers. Where it has been known that a mistake of just 1 degree for a place a thousand kilometers from the city of Mecca will deviate about 1.75 km from the actual direction. Therefore, the trigonometric theory is used to measure the direction of the qibla with spherical triangulation that models the earth in a round shape (Ahmad, 2020). Based on this explanation, it is known that trigonometry is one of the important materials that needs to be studied by students. This is strengthened by the regulation of the Minister of National Education of the Republic of Indonesia no. 23 of 2006 which states that one of the components of the competency standard for graduating grade XI science is to understand the cosine formula and apply it in problem-solving (Subroto & Sholihah, 2018). However, based on the 2011 PPMP research, it can be seen that many students tend to have low abilities in trigonometry problems (Kurniawan & Zulkardi, 2017).

Several studies show that trigonometry is difficult learning for students, including research conducted by Rumasoreng (in Riana, 2017) which stated that students have difficulty in mastering concepts and solving UN equivalent problems that contain trigonometric material. Another research conducted by Agninditya (in Riana, 2017) said that the difficulties experienced by students in trigonometric learning are that when students are given questions in the form of descriptions, students have difficulty formulating problems related to the problem. Students have difficulty in applying formulas to solve trigonometric problems because students only memorize formulas and tend to learn only from the notes given by educators so the understanding obtained by students is not satisfactory (Fajri & Nida, 2019). This shows that students need teaching

materials apart from the notes obtained from educators to help students overcome difficulties in trigonometric learning.

According to Cahyono, Tsani, and Rahma (2018), the package books available in schools are large and less practical, so they do not support students in increasing reading intensity and students' motivation to learn trigonometry is less. The results of observations made by researchers at the school where the trial was conducted found that the package books in the school were not distributed to students because the learning was carried out online. Without guidance from educators, students find it difficult when they have to learn the content of the material in the package book when they have to study at home. Based on this, the researcher wants to develop a mathematics learning module that can help educators and students, especially in trigonometry material.

Educators have an important role in choosing teaching materials that follow the material that will be mastered by students as well as being a guideline for students in learning (Nurafni, 2020). One of the teaching materials that can be used by educators is modules. According to Zhou (in Larasati & Suparman, 2018) modules are one of the learning resources that can be used to understand the concept of material containing independent learning packages that review learning materials. In the development of learning modules, accuracy in the selection of models with the materials developed is very important so that the learning process becomes more efficient and pragmatic (Bintang, Ruslan, & Nasir, 2020).

The creative problem solving (CPS) model is one of the models that is suitable for application in trigonometric learning so this model can be chosen as a learning model for the development of trigonometric modules. The creative problem solving (CPS) learning model is a problem-solving learning model that emphasizes the discovery of various alternative ideas or ideas to solve problems or find solutions that are considered the most efficient (Nopitasari, 2016). Through the use of the Creative Problem-Solving learning model, students can use their skills in solving problems by selecting and developing their responses, not only by memorizing without thinking but also by expanding their thinking process (Sari & Noer, 2017).

Research conducted by Andrik Noor Hanafi (2019) about the effectiveness of the creative problem solving learning model on mathematical disposition and students' creative thinking ability in trigonometry class shows that the creative problem solving learning model is effective on the

mathematical disposition and creative thinking ability of students. Through this model, students can be active and can find the widest possible ideas about the problems given by the teacher. By using the creative problem-solving learning model, students have problem-solving skills and can stimulate the development of students' thinking abilities creatively, rationally, and logically (Wansaubun, 2020). This shows that this learning model can improve students' problem-solving skills through the process of creative thinking. Therefore, the development of a mathematics learning module based on creative problem-solving on trigonometric material needs to be carried out.

METHODS

The module development procedure based on the creative problem-solving (CPS) learning model used is the ADDIE (analysis, design, development, implementation, evaluation) model. The ADDIE model was chosen as it provides a systematic and structured framework, from needs analysis to final evaluation, thus ensuring each stage of module development is effective. ADDIE is also iterative, allowing revisions at each stage to ensure the module meets user needs. In addition, ADDIE emphasizes continuous evaluation, allowing developers to monitor the quality of the module from start to finish. The flexibility of this model also allows its application to various types of materials and forms of learning, including creative problem solving based trigonometry modules. Activities at the analysis stage are carried out to analyze needs. The activities carried out include searching for information about student characteristics, determining the type of teaching materials to be developed, and looking for references to teaching materials that already exist on the market as support for development. The second stage in this development is to design the teaching materials to be made. The design is prepared by observing the problem and then finding a solution based on the analysis. This stage aims to prepare a design of teaching materials to be developed (Nurafni, 2020). Furthermore, the development stage in this research is carried out by creating and modifying teaching materials. The conceptual framework of the development of teaching materials that have been made at the design stage is then realized in the form of teaching material development products that are ready to be implemented. The purpose of this development is to produce or revise teaching materials that will be used to achieve the learning objectives that have been formulated and to select the best teaching materials by the learning objectives. The implementation stage is

carried out by implementing the design of teaching materials that have been developed previously in real situations in the classroom. The teaching materials that have been developed are delivered by learning. Finally, the evaluation stage includes the final step in the ADDIE development model. Evaluation is a process that is carried out to provide value for the development of teaching materials in learning. The evaluation stage is carried out after the application of teaching materials, namely by evaluating learning in the form of tests made by researchers. The results of this evaluation are used to provide feedback on the development of teaching materials. Then revisions are made according to the results of the evaluation (Cahyadi, 2019).

The subject of the product trial for the development of a creative problem-solving-based mathematics learning module on trigonometric material is class X students at SMAN 21 GOWA, precisely in class X MIPA. The product trial in this study was carried out with one data collection. The validity data of teaching materials was obtained from the results of the validator assessment. Meanwhile, data on the practicality of teaching materials was obtained from educators' responses and sheets on the implementation of teaching materials. The educator's response is known through the results of a questionnaire or questionnaire made by the researcher. Then, the effectiveness data of teaching materials was obtained from the learning outcome test and student response after using the creative problem solving-based mathematics learning module on trigonometry material, student activity observation sheets, and observation sheets of educators' ability to manage learning.

The data obtained using test instruments is then quantitatively analyzed to determine the validity, practicality, and effectiveness of the creative problem-solving-based learning modules developed. There are three types of analysis used in this study, namely validity data analysis, practicality data analysis, and effectiveness data analysis.

RESULTS AND DISCUSSION

The development of a creative problem-solving-based module on trigonometric material uses the ADDIE development model. The purpose of this research is to produce a module based on creative problem solving on trigonometry material that is valid, practical, and effective. There are five stages in the ADDIE model, namely analysis, design, development, implementation, and evaluation. The ADDIE development model itself, according to Suryani, Setiawan, and Putria (2018) consists of five stages

starting from the analysis stage, design, development, and implementation, to the evaluation stage to produce a mathematics learning module based on creative problem-solving. Regarding the creative problem-solving model, Shoimin (2014) has stated that there are four steps of the learning model consisting of four steps of creative problem-solving learning which are used by researchers as a reference in the development of modules, namely problem clarification, expression of opinions, evaluation and selection, and implementation. The learning model is the main character that the researcher wants to display in the developed module.

The results of the research obtained are described as follows.

1. Analysis

The most important stage before developing is to conduct a thorough analysis first. The activities carried out at this stage are to analyze the problems in the teaching and learning process related to the use of existing teaching materials and to analyze the need for the development of teaching materials. The analysis stage includes.

a. Analysis of the availability of teaching materials

This stage is carried out by identifying the teaching materials used by educators during the learning process. Based on the results of the observations made, information was obtained that the teaching materials used were still inadequate, and even printed books were still relatively few. This can be seen when the teaching and learning process occurs when a book is used by two people. This means that the book is only owned by a small number of students. In addition, the material presented in printed books used in learning is quite complicated for students to understand without the help of an educator. This is the reason why the researcher developed a module that can be used by students and educators, especially in trigonometry material, with the hope that the development of this module can be a learning resource for students both independently and in groups and strengthen students' creativity and understanding in terms of learning mathematics, especially in trigonometry material.

b. Instructional analysis

Instructional analysis is carried out by analyzing the subject matter. At this stage, the researcher identifies, details, and systematically arranges the main materials that students will learn. The selection of material is based on the results of the observations obtained, where the researcher found that

trigonometry is one of the materials that is quite difficult for students coupled with uninteresting and very limited teaching materials.

c. Student analysis

The students who were the subjects of the study were students from SMAN 21 Gowa class X MIPA 1. The selection of the sample is because the module developed is trigonometry where the material will be discussed in class X. The results of the study show that class X students of SMAN 21 Gowa have studied trigonometric supporting materials. The analysis of students referred to here is that the researcher examines the characteristics of students in terms of mathematical knowledge. The results of discussions with educators in the field of the study showed that the mathematical knowledge of grade X students of SMAN 21 Gowa varied, some lacked ability, medium ability, and some were quite capable.

2. Design

The next stage is design or design. In this phase, researchers begin to design teaching materials in the form of modules, learning implementation plans, learning outcome tests, and research instruments that will be used during the research.

a. Learning implementation plan

The first stage carried out by the researcher in the design or design process is the learning design which is realized by the preparation of a lesson plan. The learning implementation plan contains steps that will be carried out during the teaching and learning process. This lesson plan contains what the teacher will do before he teaches in the learning process with a systematic design so that it is expected to make the learning process effective (Gustiansyah, Sholihah, & Sobri, 2021). The components of the Learning Implementation Plan include: 1) school identity, subjects, classes/semesters, and time allocation; 2) core competencies, basic competencies, and indicators of competency achievement; 3) learning objectives; 4) learning materials; 5) learning models, approaches, and methods; 6) tools, materials, media, and learning resources; 7) learning steps consisting of preliminary, core, and closing activities; 8) assessment of learning outcomes. The implementation plan of this learning is made following the learning model used, namely the creative problem-solving model which consists of three sets for three meetings. This learning implementation plan also follows the syllabus given by the

educator who is in charge of class X of SMAN 21 Gowa. Based on these two things, a Learning Implementation Plan was developed.

b. Module

The module planning procedures are described as follows.

1) Format selection

The teaching materials in this study are made in the form of a mathematics module that contains all trigonometric materials. This learning module is made by the learning model used, namely the creative problem-solving model. The animations and stickers used in the module are partly taken from Pinterest and others are created by the researcher himself. There are 4 types of fonts used in the module, namely, the regime used in the module theme font, hashed browns used in the theme title, Patrick and used in the module subchapters, and the type of anna font used in the explanation of the module material. The format of the resulting module will be PDF and submitted to educators and students to be used during the learning process.

2) Module cover design

In this phase, researchers collect information from various sources related to how to make module covers. This information is obtained by looking at examples of various book covers or mathematics modules that have existed before to be used as a source of inspiration in determining the cover design to be made. So that the cover created will look good and attract the interest of students both in terms of color combinations and images on the cover. The selection of the title for the cover itself was taken based on the name of the subject and the learning model used. Therefore, the title of the module created is a mathematics module (trigonometry based on creative problem solving). The cover design for the module can be seen in the image below.

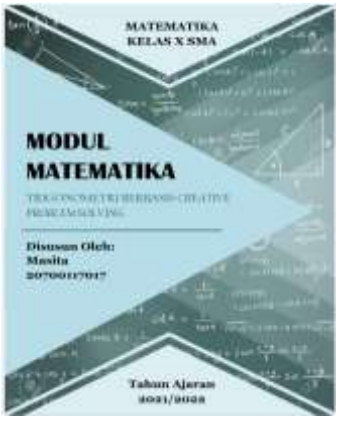

Figure 1. Cover Display

3) Module content design

The process of designing the content of the module is made by the criteria of teaching materials that must be interesting and by the needs and match with the basic competencies that will be achieved by students. The first textbook content design starts from the cover as discussed earlier. The second is a preface that contains gratitude for the completion of the module, the reason for writing the module that is delivered briefly, and the benefits that will be obtained by reading the module. The preface of the module can be seen in the image below.

Figure 2. Foreword Display

The third part is a guide to using the module which contains a brief explanation of the module and how to use it. Here's a look at the module instructions before and after the revision.

Figure 3. Instructions Before Revision

Figure 4. Instructions After Revision

The fourth part of the table of contents contains information about the topics displayed in the module along with page numbers to make it easier for readers to find the topic they are looking for. The fifth part is basic competencies, indicators, and learning objectives. This section contains the final behavior that is expected to be achieved by the reader or learner after the learning process is carried out. Parts 4 and 5 can be seen in the following image.

Figure 5. Display Before Revision

Figure 6. Display After Revision

The sixth part is a concept map that contains important information about the relationships between topics so that it is easier for readers to see the scope of the material comprehensively.

Figure 7. Concept Map Before Revision

Figure 8. Concept Map After Revision

The seventh part is the subject matter consisting of 3 themes. Each theme contains an introduction, subject matter, group assignments, learning activities, and formative tests related to trigonometry and is made according to the creative problem-solving model. The introduction contains basic competencies, indicators, and learning objectives that are specifically by the theme raised. The subject matter reviews everything related to the theme of the module. In the group assignment section, it contains problems that must be solved by students in groups. The learning activities themselves contain examples of problems related to daily life and are arranged based on the creative problem-solving model. Then the formative test section contains several questions that can be done by each student to practice understanding and problem-solving skills. This seventh part is shown in the image below.

The last part is a summary of the material from the three existing themes, a competency test of 15 questions, and a bibliography that serves as a guideline for researchers in making modules.

c. Learning outcome test

The preparation of the learning outcome test begins with compiling a test grid. The grid is then used as a guideline or reference in making the Learning Outcome Test. In this activity, the preparation of answer keys and scoring guidelines for learning outcome tests was also carried out. The test made is a test in the form of a description/essay consisting of 5 questions. The test made in this study is a learning outcome test to measure students' ability and creativity in solving problems related to trigonometry.

d. Research instruments

The instruments used in this study contain three main aspects, namely the validity aspect, the practicality aspect, and the effectiveness aspect. The validity aspect instrument consists of validation sheets which are divided into several parts, namely module validation sheets, learning implementation plan validation sheets, learning outcome test validation sheets, educator and student response questionnaire validation sheets, student activity observation validation sheets, and observation validation sheets for educators' ability to process the classroom. Furthermore, the practical instruments consist of an educator response questionnaire sheet and an observation sheet on the implementation of teaching materials. The effectiveness aspect instruments are student activity observation sheets, observation sheets of teachers' ability to process learning, student response questionnaires, and learning outcome tests.

3. Development

The next stage is the development stage, at this stage, the researcher completes the design and then submits it to a team of experts to validate the module that has been created. If the validation results require revision, then the researcher will improve the design according to the advice of the expert team. This stage is conveyed in detail in the following explanation.

a. Expert validation results

At this stage, the module is validated along with the research instruments that have been made. The expert team/validator will determine whether or not the learning module is feasible. The initial design of the resulting learning module (draft 1) will be validated by experts. The validation carried out is more focused on the aspects of graphics acclaim, linguistic aspects, content eligibility, and presentation feasibility. The assessment is carried out by checking the validation sheet that has been made by the researcher equipped with notes containing things that need to be improved and suggestions from the validator. The validators of this study consisted of two experts from lecturers at the State Islamic University of Alauddin Makassar. The names of the validators can be seen in the following table. Validation is carried out by sending modules along with research instruments to the validator's email. In addition, the validation process is also carried out by going directly to a validation expert to conduct an assessment.

Validated instruments have a high level of reliability, ensuring that measurement results remain consistent when used in different situations or at different times. Additionally, with valid instruments, researchers can minimize wasted time and resources caused by inaccurate measurements or repeated data collection processes.

b. Revision of teaching materials and validation results

The first stage of the validation process is carried out by submitting an initial design of teaching materials or modules based on creative problem-solving to the validator team. The learning module is examined and then given input. The description of the input from the validator is contained in the following table.

Table 1. Results of the First Stage of Validation

Validated Devices	Validation Results
Module	1) The presentation of the material must be more interesting, structured, systematic, and easy for students to understand 2) Formative tests need to be added to 10 questions 3) Adding material summaries and competency tests at the end of the module 4) It is worth noting the harmony of each type of font used 5) The font size should not be too large 6) Instructions for using modules are made more interesting such as using charts or charts 7) Basic competencies, indicators, and learning objectives need to be condensed again so that they are neater 8) Indicators must have a relationship with basic competencies 9) On concept maps, it is necessary to pay attention to the location of the margins. 10) Provide captions for each image used.
Learning Implementation Plan	1) Indicators in the learning implementation plan need to be included and basic competencies must be synchronized with the modules. 2) Adjusting the activities made in the learning implementation plan with face-to-face learning 3) Time allocation needs to be separated according to the learning activities that take place
Questionnaire on Responses of Educators and Students	The stated statements should be elaborated again according to the learning model used
Observation Sheet of Educators' Ability to Process Learning	The statement must be adapted to the model used in the learning process in the classroom.
Learning Outcome Test	1) The questions presented need to be condensed into only 5 items 2) Adding questions related to elevation angles and depression angles

The second stage of the validation process is carried out by submitting the results of the revision in the first validation process by the records provided by the validator team. A description of the input in the second validation can be seen in the following table.

Table 2. Second Validation Results

Validated Devices	Validation Results
Module	1) The explanation of the material needs to be clarified 2) The indicators on each theme must be related to the basic competencies of the module 3) Providing color variations in the letters in the module to make it seem attractive and bring out the creativity of researchers

After revising the suggestions and inputs in this second revision, the two validators have assessed the learning module along with other research instruments.

4. Implementation

At this stage, the product that has been developed will be applied or tested in the learning process directly on students. The trial was carried out to see the level of practicality and effectiveness of the creative problem-solving-based module. In addition, in this trial, the researcher also observed the activities of students during the learning process. After all learning activities with related modules have been completed, students will be asked to fill out a questionnaire to assess the practicality of the teaching materials used.

a. Validity test

In general, the validator assessment includes teaching materials or modules, lesson plans, Learning Outcome Tests, questionnaires for educator and student responses, observation sheets of student activities, and observation sheets of educators' ability to manage learning. The assessment data of the validation results by experts on other modules and instruments can be seen in the following table.

Table 3. Description of Expert Assessment of Research Modules and Instruments

Device	Average	Information
Module	3,58	Valid
Learning Implementation Plan	4	Valid
Student Response Questionnaire	4	Valid
Educator Response Questionnaire	4	Valid
Student Activity Observation Sheet	4	Valid
Observation Sheet on Educators' Ability to Manage Learning	3,83	Valid
Learning Outcome Test	4	Valid

The results of data analysis in table 3 show that Modules, Learning Implementation Plans, Learning Outcome Tests, questionnaires for educator and student responses, observation sheets of student activities, and observation sheets of educators' ability to manage learning are in a valid category because each aspect for each type of device reaches an average of more than 3.5, which is at intervals $3{,}26 < \bar{x} \leq 4{,}00$. In addition, the two validators concluded that the teaching materials developed along with the instruments were good and could be tested.

b. Practicality test

Practicality data was obtained from the questionnaire responses of educators and students. The results obtained are then analyzed to determine the level of practicality of the modules that have been developed. The results of data analysis for educator and student responses can be seen as follows:

1) Educator response questionnaire

The educator's response questionnaire was given after the learning activity ended. The researcher provides modules that have been made to be further assessed by educators. From the results of data analysis conducted by the researcher, the response of educators to the learning modules developed was 100%. The value is at the interval of $85\% \leq v \leq 100\%$ RS with a very positive category, so it is concluded that the practicality criteria for educator responses are achieved.

2) Description of the results of observation of the implementation of teaching materials

Observation of the implementation of teaching materials in the form of trigonometric learning modules based on creative problem-solving was carried out at each meeting. Observations were made to determine the level of

practicality of teaching materials in the form of modules developed. Observations were made by two observers using instruments that had been made by the researcher. The results of the analysis for the observation of the implementation of this teaching material show that the average of each aspect of observation in the three meetings is 1.92 which is in the interval of 1.5 ≤ AD ≤ 2. Thus, all aspects of the implementation component of teaching materials are in the category of fully implemented. The average percentage of the two observers from the first to the last meeting is 90%, so it can be said that the observation of the learning module based on creative problem-solving is included in the reliable category because of its reliability value (R)0.75.

Based on the two practical components above, namely the educator response questionnaire and the observation sheet on the implementation of teaching materials, it was obtained that the results of the analysis of both showed a very positive response to the educator's response, which was 100%. Meanwhile, the results of the analysis of the implementation of teaching materials were 1.92 which was in the category of fully implemented with an interval of 1.5 ≤ M ≤ 2. Thus, the module developed meets the practical criteria and there are no improvements to the module.

c. Effectiveness test

The effectiveness of the module is measured using 4 components, namely student activities, teachers' ability to process learning, student responses, and learning outcome tests. The results of the three components are described as follows.

1) Description of student activity results

Students' activities during the learning process are observed based on 5 categories, namely: (a) students read and observe the problems in the module, (b) students form groups to solve problems in the module, (c) students freely express their opinions about the problems presented, (d) students discuss and choose solutions from problems that are considered correct with their group friends, and (e) students present and draw the most appropriate conclusions from the problems presented. The results of data analysis show that during the learning process using creative problem-solving-based mathematics learning modules, students are actively involved. The percentage of student activities during learning is 72.33%. The debut number is in the interval of 60% ≤ P < 80% with the good category. Thus, student activities using creative problem-solving-based mathematics learning modules meet the effectiveness aspect.

2) Description of educators' ability to cultivate the classroom

The analysis of the ability of educators to process learning is intended to determine the safe extent of the ability of educators to manage mathematics learning using mathematics learning modules based on creative problem-solving in the classroom. After data analysis, the average score of educators was 4.47 at an interval of 3.50 ≤ crime scene < 4.50 with a good category. From the results of the analysis, it was concluded that the ability of educators to manage mathematics learning using creative problem-solving-based mathematics learning modules was in a good category so it met one of the components of effectiveness.

3) Description of student response

The student response questionnaire was distributed to 12 students who are students of class X MIPA 1 after participating in a series of learning for 3 meetings using a mathematics learning module based on creative problem solving on trigonometry material. The results of this component data analysis show that the average percentage of student responses to learning activities using the module in question has a value of 83.89%. This figure is in the interval of 70% ≤ 85% of < hospitals with a positive category so that it can be concluded that the student response criteria have also been achieved.

4) Description of learning outcomes achievement

The analysis of the learning outcome test which was attended by 12 students was carried out by checking the students' answers using scoring guidelines.

Table 4. Results of Learning Outcome Test Analysis

Achievement Level	Frequency	Percentage	Qualification
91% −100%	2	16,67%	Very High
75% −90%	6	50%	High
60% −74%	4	33,33%	Medium
0% −59%	0	0	Low

Referring to the table above, it is known that of the 12 students who took the learning outcome test, 2 students were included in the very high category at the interval of 91% -100%, 6 students with a high category at the interval of 75% - 90%, and 4 students were in the medium category at the interval of 60% - 74%. Based on completeness, there were 8 people out of 12 students who obtained a score of 75 and above. While the other 4 obtained a score below 75. Some of the factors are due to a lack of motivation to learn and

a lack of participation during group work, resulting in a lower understanding of the material compared to other students. So that the analysis of the learning outcome test data shows that the percentage of student completeness is 80.42%. Thus, it can be concluded that the learning outcome test meets one of the components of effectiveness.

Based on the four effectiveness criteria above, namely student activities, teachers' ability to process learning, student responses, and learning outcome tests, it can be concluded that the results of the analysis of student activities are in a good category with an interval of 60% ≤ P < 80%. The results of the analysis of teachers' ability to process learning are in the good category with an interval of 3.50 ≤ crime scene < 4.50. The results of the analysis of student response were 83.89% in the interval of 70% ≤ < 85% of the hospital with the positive category. Meanwhile, the analysis of learning outcome test data showed that the percentage of student completeness was 80.42%. Thus the modules developed meet the criteria for effectiveness.

5. Evaluation

This stage is the final stage of the ADDIE development model. The results of the evaluation obtained are then used as feedback for the modules developed. At this stage, the evaluation is carried out from the analysis stage to the implementation stage. From the results of the evaluation, input was obtained from educators and students where the questions made were more related to the daily life related to the surrounding environment of the students. In addition, educators also expect answer keys from questions that are made specifically for educators to make it easier for educators to use the module.

The advantage contained in this module is that the materials presented are complemented by events that occur in daily life. So that students can directly relate mathematical problems to their daily lives. In addition, several problems are presented with two alternative solutions to awaken the creative side of students. This is in line with Anggoro's statement (in Ariskasari & Pratiwi, 2019) that the use of modules in teaching and learning activities can direct students to think creatively. Problem-solving in the module is also made by the syntax of the creative problem-solving model. This will make it easier for students to understand how to solve problems as well as facilitate the process of understanding the learning model applied. The shortcomings in this study are the limitations of developing only trigonometric materials and

adjusting the learning model to the characteristics of the students who are the test subjects.

This mathematics learning module is designed by the applicable curriculum in the school and by the level of education. The researcher chose the module as the teaching material to be developed because it is based on Zhou's statement (in Larasati & Suparman, 2018) that one of the learning resources that can help students understand mathematical concepts according to the material reviewed is the module. This creative problem-solving-based module contains a cover page, a preface, instructions for using the module, a table of contents, basic competencies and indicators, a concept map, trigonometric materials, a summary, a competency test, and a bibliography. The material in the module itself is divided into 3 themes, namely recognizing and measuring trigonometric ratios, the relationship between angles in trigonometry and its rules, and graphs of trigonometric functions. Each theme in the module consists of an introduction (KD, learning objectives, and indicators), material explanation, group assignments, learning activities that contain examples of the application of the material in daily life, and formative tests used to train students' ability to solve problems related to trigonometry. The module components made by the researcher are adjusted to the module components presented by Suryosubroto (in Asiz, 2019), namely instructions for using the module, learning objectives, activity sheets, worksheets, and also the addition of other components such as covers, prefaces, table of contents, list of figures, list of tables, concept maps, core competencies, basic competencies, competency achievement indicators, and literature. So it can be said that the module created by the researcher has contained all the necessary components.

Based on the results of the above study, it can be said that this study is in line with the results of the research of Wijawanti and Sungkono (2017) who concluded that the creative problem-solving learning model is effective to be used in classroom learning. In addition, Hu, Xiaohui, and Shieh (2017) also stated that CPS learning affects students' learning achievement in a positive direction. The existence of this study further strengthens the results of previous research, where the results of the analysis of the learning outcome test prove that this learning model helps students improve learning outcomes in a positive direction. Unlike previous research that only focused on measuring the effectiveness of the learning model, the researcher took another focus to apply the learning model to a module that has been tested with valid,

practical, and effective criteria so that it can be used by students in the learning process.

CONCLUSION

Based on the results of the research and discussion, it can be concluded that the mathematics learning module based on creative problem-solving was developed through the ADDIE development model, which includes the stages of analysis, design, development, implementation, and evaluation. This stage aims to produce mathematics learning modules on trigonometric material that are valid, practical, and effective. A quality learning module must meet three main criteria, namely validity, practicality, and effectiveness. The validity criteria are indicated by the results of module validation with a score of 3.58, which is categorized as valid. The practicality criteria of the module are seen from several aspects, including a very positive response from educators of 100% and the implementation of teaching materials of 1.92, which shows that the teaching materials are fully implemented. Meanwhile, the effectiveness criteria were assessed based on student activities which reached 72.23% with a good category, the ability of educators to manage classes which obtained a score of 4.47, and the positive response of students to the module of 83.89%. In addition, the percentage of completeness of student learning outcomes reached 80.42%. Based on these results, the creative problem-solving-based learning module was declared to meet the criteria of valid, practical, and effective.

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