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Development of Mathematic Learning Devices Based on Discovery Learning Model To Facilitate Students' Mathematic Communication Ability

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A B S T R A C T

The condition of the learning equipment used by the teacher is not in accordance with the demands of the 2013 curriculum. Learning activities and Student Worksheets (LKPD) used in the learning process have not been able to facilitate the improvement of students' Mathematical Communication Ability (KKM). Teachers have not designed learning tools that can encourage student activities to facilitate the improvement of KKM. This study aims to produce learning tools based on the Discovery Learning model to facilitate the improvement of the KKM of students that are valid and practical. This development research uses the ADDIE development model with the stages of Analysis, Design, Development, Implementation, and Evaluation. The products produced from this research on the development of learning tools are syllabus, lesson plans, LKPD and KKM questions. The results of the validation test for the syllabus, RPP, LKPD and KKM questions obtained consecutively a percentage of 92.19%, 93.37%, 93.14% and 94.64% with very valid categories. The practicality test results got a percentage of 84.52% for small group trials and 94.00% for teacher responses in the very practical category. The results of the validation and practicality test state that mathematics learning tools based on the Discovery Learning model can facilitate students' Mathematical Communication Ability.

1. Introduction

The 2013 curriculum that is used by schools at this time requires teachers to prepare designs of learning activities that can encourage student activity in learning. This is in line with Nana. (2011) statement which states that the curriculum is an educational design that summarizes all learning experiences provided for students. The 2013 curriculum demands that the learning process in

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educational units be carried out in an interactive, inspirational, fun, challenging, motivating students to actively participate, and provides sufficient space for the initiative, creativity and independence of students (Permendikbud No. 22 of 2016).

The implementation of education based on the 2013 Curriculum makes the role of teachers more complex, because the demands of teachers are not only teaching and educating students, but also are expected to be able to become facilitators so that the role of education becomes more meaningful. Teachers are required to design a learning process that is interactive, inspiring, fun, challenging and motivates students to actively participate in the learning process. Teachers are also required to provide opportunities for students to give ideas that they have in creativity and make students independent in the learning process. According to Ardina, a poor learning design will result in inefficient learning (Resmi et al., 2020).

The learning process requires a learning plan designed in the form of a syllabus and a lesson plan (RPP) which refers to the content standard. The syllabus is structured to see the outline of the learning framework and is adjusted to Core Competencies (KI) and Basic Competencies (KD). The syllabus is used as a reference in developing lesson plans. RPP is a plan of learning activities that teachers use in the learning process. RPP is a guide for learning activities carried out by teachers in learning. The learning to be carried out is fully controlled by the teacher. Therefore teachers must be able to develop and implement learning that can increase student activity. This is in line with the competencies that must be possessed by teachers as stated in the 2017 Directorate General of Primary and Secondary Education that teachers must have the competence to plan learning and carry out a quality learning process (Nur et al., 2020). In addition, Permendikbud No. 87/2013 explains that teachers must be able to develop comprehensive learning tools (Dwi et al., 2018).

The learning tools used by teachers are not currently able to facilitate Mathematical Communication Skills. This is because teachers have not developed tools independently in accordance with the demands of the curriculum and the characteristics of students. Based on a preliminary study conducted by researchers on four high school mathematics teachers, it was obtained information that from the four teachers, not one teacher made learning tools independently. Two teachers use the tools from the publiser by replacing school and personal data that are adjusted to the teacher's data. One teacher uses the MGMP learning tools. One teacher did not even make a learning device on the grounds that the questions for this material rarely appear on the UN questions. The learning device used was not tested for validity and practicality before being used, so there are still many things that need to be improved.

The results of the researchers' observations on the syllabus used by the teacher showed that the indicators of competency achievement were not included, the time allocation was only written in the total number of lesson hours, the skills assessment only by discussion and discussion was considered inappropriate in

showing the assessment of mathematical skills. Then the textbooks or learning resources used are not books with the latest edition of the curriculum which are likely to have changes. The results of the researchers' observations on the lesson plans used by the teacher did not show the learning objectives describing the process and learning outcomes of students as a whole in accordance with the basic competencies and predetermined indicators. Then the details of the distribution of the material in the lesson plan show facts, concepts, principles and procedures. Furthermore, the assessment in the RPP does not include assessment instruments and rubrics.

Mathematical Communication Skills is the ability to describe an algorithm and a unique way of solving a problem. Mathematical communication skills are very important for students. This is because Mathematical Communication Skills provide opportunities for students to acquire and construct the mathematical concept itself (Nur et al., 2020). Then Mathematical Communication Skills can also help students solve problems more quickly, and be able to present problems correctly and Mathematical Communication Ability is also a requirement for students to solve mathematical problems well (Mulin., 2015). According to Puji, in the world of education the learning process is identified by the process of delivering information or communication (Hany et al., 2020).

Students' mathematical communication skills are currently still low. The low mathematical communication skills of students can be seen from the skills and accuracy of students in observing or recognizing a mathematical problem which is still low and students have not been able to communicate mathematics in written and oral form well (Mulin., 2015). Low Mathematical Communication Skills can also be seen in Nur et al. (2020) which states that there are still many students who cannot express daily events in language or mathematical symbols from the questions given. Furthermore, in research conducted by Elly et al. (2017) it was also stated that Indonesian students in mathematics communication were very far below other countries, for example, for mathematical problems related to Mathematical Communication Ability, Indonesian students who managed to answer correctly were only 5% and far below countries such as Siangpura, Korea and Taiwan which account for more than 50%. Then in research conducted by Nuraini. (2016) said that communication skills received less attention from the teacher to be developed because they thought that Mathematical Communication Ability could not be developed, the teacher did not give opportunities to students to communicate ideas so that students had difficulty in providing explanations correct and logical answer, and the teacher's focus is only on achieving the completion of the material, so that he does not pay attention to improving Mathematical Communication Ability.

The low mathematical communication skills of students can also be seen from the answers of students in solving mathematical problems in the material of the rules of sines and cosines. Students' answers show that students still have difficulty identifying the problem given. Learners cannot properly make information what is known. Then for the mathematical modeling made by students of the given problem is not clear and raises new questions. This will lead to student errors in

determining problem solving and misunderstandings between students as information givers and recipients of information. Students' answers also show students cannot understand the problem well, so that students ignore some instructions or commands presented in the problem. The student's answer then shows that students cannot write down ideas and concepts of the problem to be solved and the information from the solutions obtained is not explained properly. This shows that the writing skills of students are still low.

Preparations that can be done to improve the learning process in the classroom to facilitate the improvement of Mathematical Communication Skills on the sine and cosine rules material is to apply the Discovery Learning (DL) learning model. The DL model is in accordance with the learning theory put forward by Bruner, namely the learning process will run well and creatively, if the teacher provides the opportunity for students to find a rule (including concepts, theories, definitions, and so on) through examples that illustrate / represent the rules that are the source (Uno., 2008). The DL model can help students train their communication skills. This is in line with the results of research by Kodirun et al. (2016) that the mathematical communication skills of students can be improved by using discovery learning through lesson study. In addition research, the Mathematical Communication Ability of the DL model learning device to Mathematical Communication Ability is effective (Arifatud et al., 2015). Then research conducted by Yeni et al. (2017) also states that the DL Model improves Mathematical Communication Ability in the moderate group better than the high and low groups.

Developing Mathematical Communication Skills requires teachers to be able to develop Student Worksheets (LKPD). The DL model can be integrated in the development of teaching materials in the form of LKPD on the sine and cosine rules material. As stated in the results of research by Dwi et al. (2018) that teaching materials for sine and cosine rules based on discovery learning through the ethnomatematic approach have very valid criteria. The difficulty of students in learning the sine and cosine rules material was found by Karmila et al. (2016) in their research which stated that the results of interviews with 30 students were only 1 person who stated that the sine and cosine rules material was easy to understand. In addition, Mulin. (2015) in his research said that the teaching materials used in learning only contained definitions, theorems, proofs, examples of questions and practice questions. Then Bayu et al. (2018) in their research found that most teachers today prefer to use LKPD provided by publishers. The teacher learning process uses the BSE book which only contains basic mathematical concepts and a few questions related to problems that are in accordance with the situation found in the research of Fatimatul et al. (2016). Furthermore, in the research of Lisa et al. (2018), it was shown that student handbooks during the implementation of learning were using LKPD obtained from distributors and there were no learning tools oriented to science skills. While the researchers themselves cannot observe the student worksheet developed by the teacher, because the teacher only uses student activity sheets found in the textbook.

Based on the problems described above, teachers are required to develop learning tools that are able to encourage student activity and in accordance with the characteristics of students. The DL model can help improve student activity in learning. The purpose of this study is to develop a mathematical learning device based on discovery learning models to facilitate valid and practical mathematical communication skills of students.

2. Methodology

This development research used the ADDIE R&D development model, namely (A) analysis, (D) esign, (D) development, (I) implementation, and (E) valuation. Nancy said that the ADDIE model is a model that can adapt very well to various conditions, the level of flexibility of this model in answering problems is quite high, is effectively used, and provides a common and structured framework (Nur et al., 2020). The subjects of this study were students of class X MA Darul Hikmah Pekanbaru.

The first stage was the analysis stage. The analysis stage consists of two stages, namely performance analysis and needs analysis. Performance analysis is carried out to determine the difficulties that teachers find in the learning process by looking at the learning tools used by the teacher in the learning process. Needs analysis is carried out to find out the problems faced by students in learning.

The second stage was the design stage. Based on the performance and needs analysis that has been carried out, then collect relevant references as materials for designing learning tools on the material of the sine and cosine rules and research instruments. The design stage is the activity of designing learning devices and instruments used in research. The design of learning devices is adjusted to the Basic and Secondary Education Process Standards and applies the DL model as well as a scientific approach.

The third stage was the development stage. The development step is in the form of producing or creating or realizing the learning product specifications that have been determined at the design stage. The learning tools produced in this study are syllabus, lesson plans, and student worksheet. Learning tools that have been developed are then evaluated by the validator. The learning tool validator consists of three validators. The criteria for being a validator are at least a S2 education from a high school math teacher and at least a doctoral degree from a lecturer in mathematics education. The results of the validation that were carried out were then analyzed and revised according to the validator's suggestions and the results of the discussion with the supervisor.

The fourth stage was the implementation stage. Learning devices that have been validated by experts and have met the valid category, are then tested. The small group trial in this study consisted of 15 people from class X Sains 2 MA Darul Hikmah Pekanbaru who were randomly selected with heterogeneous abilities, namely students with low, medium and high abilities. The small-scale trial aims to

see the legibility of the LKPD on the material for the rules of sines and cosines that have been developed.

The fifth stage was the evaluation stage. The evaluation stage is carried out at each development stage for the perfection of the development of learning devices. Evaluation is carried out based on input from supervisors, validators, teachers and students.

The data analysis in this study was the analysis of the validation sheet, student response questionnaires and teacher response questionnaires. Analysis of the validation sheet by determining the average percentage of validation from the validator on the table 1. Analysis of the response questionnaire to determine the level of practicality on the table 2.

Table 1 Category of Learning Tool Validity

Interval	Category
85,01 % - 100,00%	Very Valid
70,01 % - 85,00 %	Valid
50,01 % - 70,00%	Less Vallid
01,00 % - 50,00%	TInvalid

Source: Sa'adun. (2013)

Table 2 Categories of Learning Devices Practicality

Interval	Category
80,01 % - 100,00%	Very Practical
60,01 % - 80,00 %	Practical
40,01 % - 60,00%	Practical Enough
20,01 % - 40,00%	Less Practical
00,00% - 20,00%	Not Practical

Source: Sa'adun. (2013)

3. Results and Discussion

The products that are produced from this research are in the form of mathematics learning tools in the form of syllabus, lesson plans, LKPD and questions on mathematical communication skills on the material of sine and cosine rules.

The development process begins with a performance analysis and a needs analysis. The results of the performance analysis get information that teachers tend to use tools from MGMP, publishers, the internet and others. This information is obtained from questions about the technique of preparing the syllabus and lesson plans independently. Of the four teachers interviewed, none of the teachers developed learning tools independently and completely. The teacher only edits the syllabus and lesson plans from previous years, which is replaced by the school year and other things that are tailored to the needs of each teacher in the field of study. This is because the teacher cannot allocate time for each KD, develop competency attainment indicators, develop learning objectives at each

meeting, and develop learning activities. The syllabus and lesson plans compiled by the teacher do not meet the components contained in Permendikbud Number 22 of 2016. The time allocation required for the material for the Rules of Sines and Cosines is four meetings.

The results of the needs analysis get information that the involvement of students in learning mathematics is still low. Of the 28 students, there were 9 people who recorded the material explained by the teacher and 14 people who paid attention to the teacher's explanation. Students focus on the teacher 15 minutes at the beginning of the lesson. Students feel that notes can be seen in textbooks and see friends' notes and can ask smart friends back. Students are more likely to discuss with friends than ask the teacher. This shows that students like to do a learning activity together. Therefore, learning can be done with a learning model that makes learning activities in groups so that students can have discussions. One learning model that organizes students for group learning that can be used is the DL model. The DL model provides stimulation in the form of an event or problem at the beginning of learning that makes students discuss the event or problem to be solved together.

The results of the analysis of Mathematical Communication Skills get information that students still have difficulty identifying the problems given. Learners cannot properly make information what is known. Then for the mathematical modeling made by students of the given problem is not clear and raises new questions, such as making points A, B and C unclear. This resulted in unclear line segments AB, AC and BC. Then students ignore some of the instructions or commands presented in the problem. This shows that the students' mathematical communication skills are still not good. Students are expected to be able to communicate daily problems by making mathematical ideas from the problems given in the form of mathematical models and solving them. Furthermore, the students' answers showed that students could not write down the ideas and concepts of the problems they would solve and the information from the solutions they obtained was not well explained. The answers of these students can be seen in Figure 1.

The next step is to design learning tools. The learning device is designed in accordance with KI and KD in Permendikbud Number 21 of 2016 which is related to the material of sine and cosine rules based on the DL model, a scientific approach and contains indicators of Mathematical Communication Ability. The draft syllabus and lesson plans refer to Permendikbud Number 22 of 2016. The Student Worksheet (LKPD) contains guidelines or steps for investigating or solving a problem. The LKPD design is adapted to the Discovery Learning (DL) model, a scientific approach and contains indicators of Mathematical Communication Ability. LKPD is designed and used for each RPP that has been developed. In this study, researchers developed four LKPDs on the sine and cosine rules material.

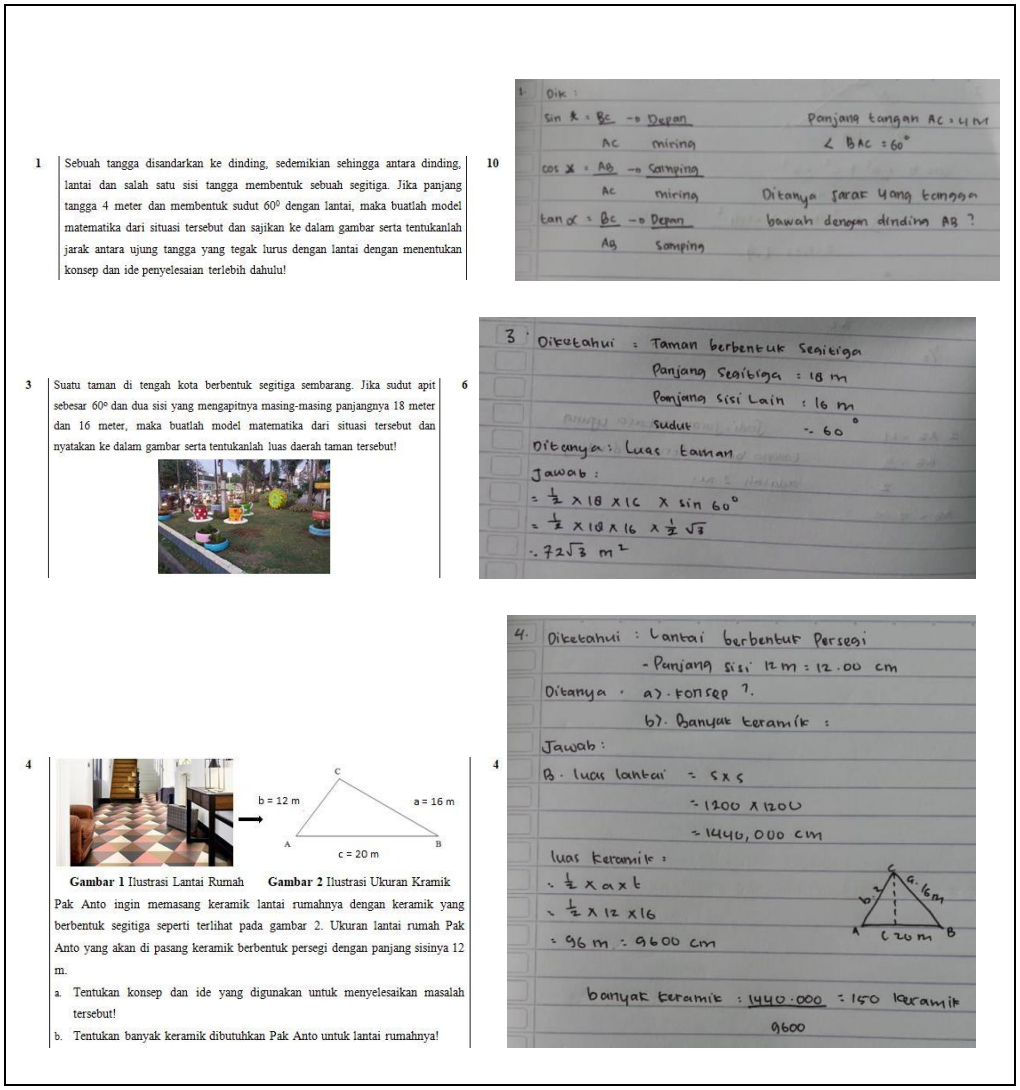


Figure 1. Students' Mathematical Communication Ability Test Results

After the design process, then the production stage is in accordance with the learning device development design. Each design is described in great detail.

Kompetensi Dasar	Materi Pokok/ Materi Pembelajaran	Indikator Pencapaian Kompetensi	Kegiatan Pembelajaran	Penilaian	Alokasi Waktu	Sumber Belajar
3.9 Menjelaskan aturan sinus dan cosinus 4.9 Menyelesaikan masalah yang berkaitan dengan aturan sinus dan cosinus	2. Aturan Cosinus	3.9.3 Menemukan rumus aturan Cosinus. 3.9.4 Menentukan nilai unsur-unsur suatu segitiga sembarang dengan menggunakan konsep aturan Cosinus. 4.9.2 Menyelesaikan masalah yang berkaitan dengan aturan cosinus menggunakan kemampuan komunikasi.	Pembelajaran dilaksanakan dengan menerapkan model *Discovery Learning* dengan pendekatan saintifik yang meliputi mengamati masalah, menanya, mengumpulkan informasi, menalar, dan mengkomunikasikan terkait dengan aturan cosinus.	Pengetahuan: 1. Tes Tertulis 2. Tes Lisan 3. Penugasan Keterampilan: Tes Tertulis (Soal Uraian) Sikap: Lembar pengamatan	2 x 45 menit	LKPD-2 tentang Aturan Cosinus Buku B. K. Noormandiri (Matematikan untuk SMA/MA Kelas X Kelompok Wajib) Kurikulum 2013 Revisi, Erlangga. Buku Masduki dan Suciyati SN (Matematika untuk SMA/MA Kelas X) Kurikulum 2013, Masmedia. Buku Sutrisna dan Slamet Waluyo (Konsep dan Penerapan Matematika SMA/MA/SMK/MaK kelas X) Kurikulum 2013 edisi revisi 2016, Bumi Aksara. Media Visual *Power Point*

Figure 2. Example of Syllabus Development Results

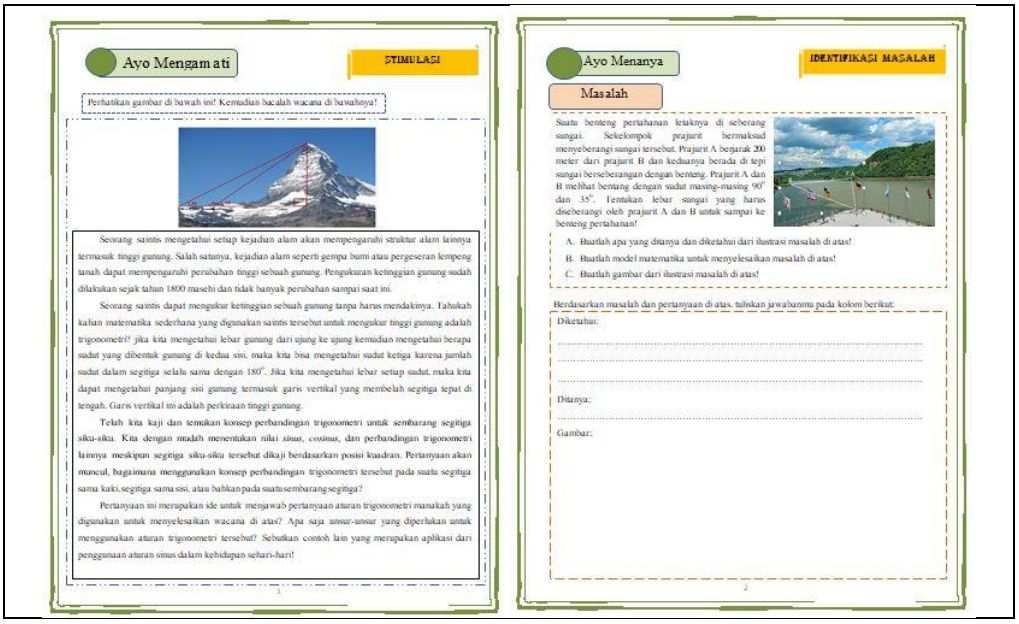
Figure 2 shows that the presentation of the syllabus developed by the researcher is in accordance with the demands of the 2013 curriculum. Development of the syllabus refers to Permendikbud Number 23 and Number 24 of 2016 as well as the presentation of material relevant to KD (Kemendikbud., 2017).

Kegiatan Inti	**Fase 1: *Stimulation* (stimulasi/pemberian rangsangan) (Mengamati)** 8. Peserta didik mengamati dan memahami aplikasi aturan sinus dalam kehidupan sehari-hari yang disajikan dalam bentuk gambar dan narasi seperti berikut:  Seorang saintis mengetahui setiap kejadian alam akan mempengaruhi struktur alam lainnya termasuk tinggi gunung. Salah satunya, kejadian alam seperti gempa bumi atau pergeseran lempeng tanah dapat mempengaruhi perubahan tinggi sebuah gunung. Pengukuran ketinggian gunung sudah dilakukan sejak tahun 1800 masehi dan tidak banyak perubahan sampai saat ini. Seorang saintis dapat mengukur ketinggian sebuah gunung tanpa harus mendakinya. Tahukah kalian matematika sederhana yang digunakan saintis tersebut untuk mengukur tinggi gunung adalah trigonometri? jika kita mengetahui lebar gunung dari ujung ke ujung kemudian mengetahui berapa sudut yang dibentuk gunung di kedua sisi, maka kita bisa mengetahui sudut ketiga karena jumlah sudut dalam segitiga selalu sama dengan 180^0. Jika kita mengetahui lebar setiap sudut, maka kita dapat mengetahui panjang sisi gunung termasuk garis vertikal yang membelah segitiga tepat di tengah. Garis vertikal ini adalah perkiraan tinggi gunung. Aturan trigonometri manakah yang digunakan untuk menyelesaikan wacana di atas? Apa saja unsur-unsur yang diperlukan untuk menggunakan aturan trigonometri tersebut? 9. Peserta didik diminta untuk memberikan contoh lainnya yang merupakan aplikasi dari aturan sinus dalam kehidupan sehari-hari.	70	**Fase 2: *Problem Statement* (identifikasi masalah). (Menanya)** 10. Guru menyajikan masalah berikut:  Suatu benteng pertahanan letaknya di seberang sungai. Sekelompok prajurit bermaksud menyeberangi sungai tersebut. Prajurit A berjarak 200 meter dari prajurit B dan keduanya berada di tepi sungai berseberangan dengan benteng. Prajurit A dan B melihat bentang dengan sudut masing-masing 90^0 dan 35^0. Tentukan lebar sungai yang harus diseberangi oleh prajurit A dan B untuk sampai ke benteng pertahanan! 11. Peserta didik mengidentifikasi masalah di atas dengan menuliskan apa yang diketahui, ditanyakan, dan membuat model matematikanya, serta skesta gambar dari masalah tersebut. 12. Peserta didik menentukan hipotesis atau jawaban sementara dari masalah di atas dengan mengungkapkan ide dan konsep untuk menyelesaikan serta menentukan altenatif penyelesaian dari masalah tersebut.

Fase 3: *Data Collection* (pengumpulan data) **(Mengumpulkan Informasi)** 13. Peserta didik mencari berbagai informasi yang relevan dengan masalah yang diberikan tentang aturan sinus dari berbagai sumber. 14. Guru mengarahkan peserta didik untuk mendiskusikan penggunaan perbandingan trigonometri dan garis tinggi sebagai langkah awal untuk menemukan rumus aturan sinus.
Fase 4: *Data Processing* (pengolahan data) 15. Guru mengarahkan peserta didik untuk berdiskusi menemukan rumus aturan sinus dengan berbagai informasi yang telah diperoleh pada tahap pengumpulan data. 16. Peserta didik menuliskan rumus umum aturan sinus pada sembarang segitiga, sebagimana kesimpulan dari hasil diskusi kelompok pada tahap pengolahan data. 17. Peserta didik menggunakan rumus aturan sinus untuk menyelesaiakan masalah yang disajikan.
Fase 5: *Verification* (pembuktian) **(Menalar)** 18. Peserta didik memeriksa kembali hasil kerjanya sebagai bukti bahwa aturan sinus dapat digunakan untuk segitiga sembarang. 19. Peserta didik memberikan tanggapan atau pendapat terhadap perbandingan jawaban sementara (hipotesis) dengan jawaban yang diperoleh pada tahap pengolahan data.
Fase 6: *Generalization* (menarik keseimpulan/generalisasi) **(Mengkomunikasikan)** 20. Peserta didik diminta untuk menuliskan kesimpulan tentang aturan sinus yang diperolehnya. 21. Guru meminta perwakilan kelompok untuk menyajikan secara tertulis atau lisan hasil diskusi kelompok dalam pembelajaran yang telah dilaksanakan. 22. Peserta didik lainnya menyimak dan memberi tanggapan hasil presentasi kelompok penyaji meliputi tanya jawab untuk mengkonfirmasi, sanggahan, alasan, memberikan tambahan atau melengkapi informasi dan hal-hal lainnya yang bersifat membangun. 23. Guru dan peserta didik lainnya memberikan apresiasi kepada tim penyaji dan peserta didik yang aktif dalam diskusi.

Figure 3. DL steps are described in detail in the RPP

Figure 3 shows the RPP is in accordance with the demands of the 2013 curriculum. Development of RPP refers to Permendikbud Number 22, Number 23 and Number 24 of 2016. The formulation of the GPA in the RPP already uses operational verbs that can be measured and are in accordance with the specified KD, learning objectives in the RPP has contained elements of ABCD (audience, behavior, conditions, and degree) (Ridwan., 2018).



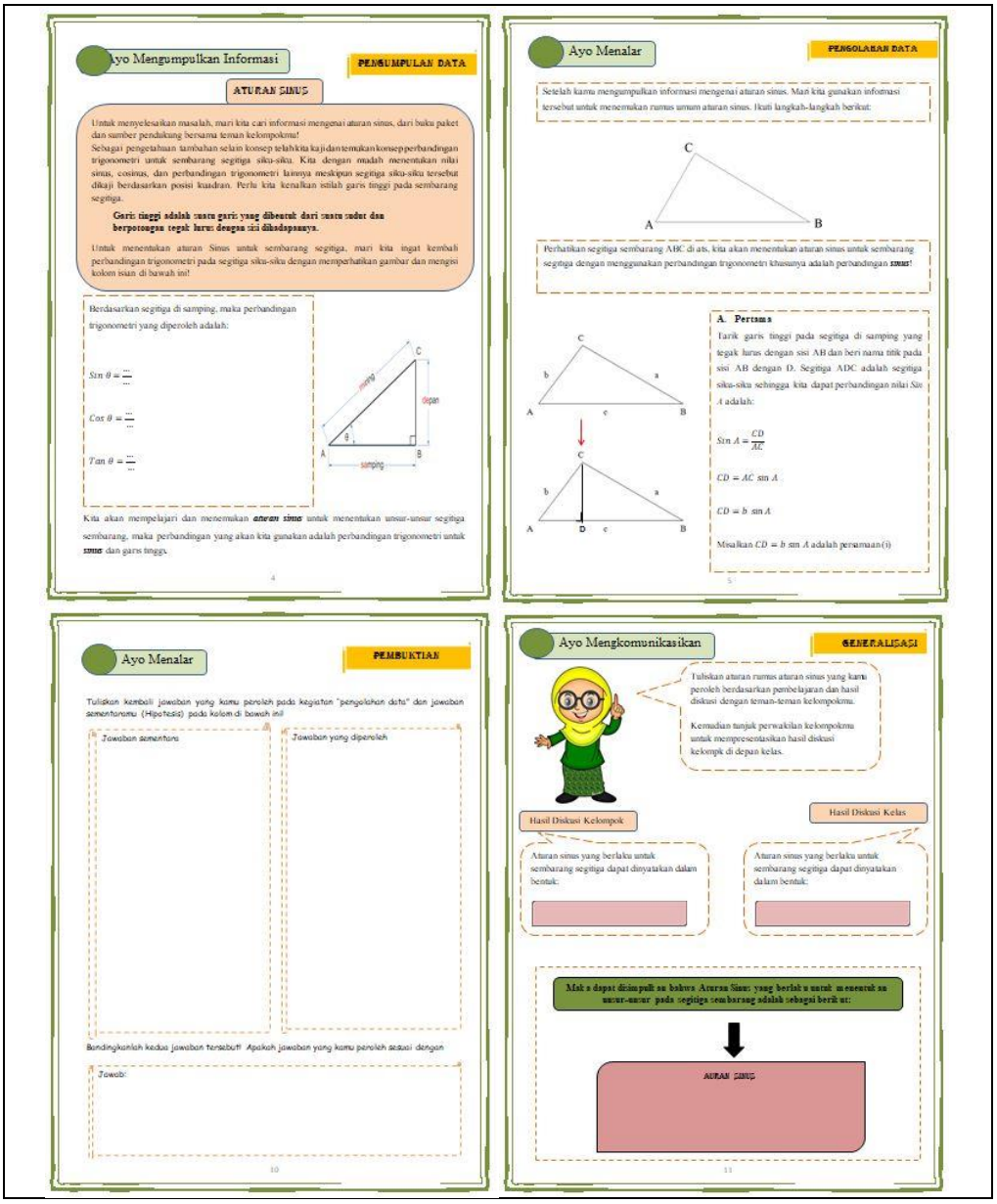


Figure 4. DL and Scientific steps in LKPD

Figure 4 shows that the development of LKPD is in accordance with the completeness of the components required in the LKPD (Depdiknas., 2008), learning materials that contain facts, concepts, principles and procedures are relevant to KD (Kemendikbud., 2017), didactic requirements or the ability level of students (Endang., 2008), the language used has been adjusted to correct Indonesian, and is simple so that it is easy for students to understand as stated and LKPD has also been designed with attractive colors and the images presented can help students understand the material (Rena., 2017).

Learning tools that have been produced are then validated. The validation result of the syllabus from the validator shows a value of 92.19% with a very valid category. There are no suggestions and input given by the validator on the

syllabus. These results were obtained because KI and KD are in accordance with the core competencies and basic competences of subjects listed in Permendikbud Number 24 of 2016. The learning material contains facts, concepts, principles and procedures that are relevant to KD (Kemendikbud., 2017) and has been presented coherently. . The assessment on the syllabus contains aspects of the assessment of attitudes, knowledge and skills, which are in accordance with the demands of Permendikbud Number 23 of 2016. The tools, media and learning resources used have been good in helping students understand the material to be studied and learning resources have been written in a more operational (Daryanto et al., 2014).

The RPP validation results from the validator showed a value of 93.47% with a very valid category. This result was obtained because the completeness of the RPP identity was in accordance with the standard of the primary and secondary education process as contained in Permendikbud Number 22 of 2016. The clarity of KI and KD is in accordance with KI and KD in Permendikbud Number 24 of 2016. The formulation of GPA in the RPP has been prepared using operational verbs that can be measured and in accordance with the specified KD and the learning objectives in the RPP contain ABCD elements (audience, behavior, conditions, and degree) (Ridwan., 2018). Learning materials that contain facts, concepts, principles and procedures are relevant to KD (Kemendikbud., 2017) and have been presented coherently. Learning activities are in accordance with the learning steps as contained in Permendikbud Number 22 of 2016. The learning activities arranged can improve students' Mathematical Communication Ability, this is in accordance with the research of Dwi et al. (2018) that the development of learning tools with learning models discovery learning can improve students' mathematical communication skills. The media and learning resources used can support learning activities with discovery learning models, can support achieving learning objectives and are in accordance with the characteristics of students (Kemendikbud., 2017). The assessment in the RPP includes aspects of the assessment of attitudes, knowledge and skills, which are in accordance with the educational assessment standards listed in Permendikbud No. 23 of 2016.

The results of the LKPD validation showed a value of 93.14% with a very valid category. This result was obtained because the completeness of the LKPD identity was in accordance with the completeness of the components required in the LKPD according to the Ministry of National Education (2008). Learning materials that contain facts, concepts, principles and procedures are relevant to KD (Kemendikbud., 2017) and have been presented coherently. The LKPD development is in accordance with the DL steps. As the research results of Dwi et al. (2018) state that the results of developing teaching materials using DL steps fulfill the valid category. The LKPD developed is in accordance with the indicators of mathematical communication capabilities (Kodirun et al., 2016). LKPD has been developed in accordance with didactic requirements or the ability level of students (Endang., 2008). The language used has been adjusted to correct Indonesian, and is simple so that it is easy for students to understand and the LKPD developed meets the requirements for the presentation of the LKPD, which must use the appropriate front (type and size) letters and the LKPD has also been

designed with attractive colors and The images presented can help students understand the material (Rena., 2017).

The results of the validation of the Mathematical Communication Ability show a value of 94.64% with a very valid category. This result was obtained because the Mathematical Communication Ability questions developed had clearly contained sentence formulations, scoring guidelines and graphs, figures, tables etc. The Mathematical Communication Ability problem that was developed was in accordance with the items and the indicators that were arranged, the questions could measure the Mathematical Communication Ability indicators and the expected questions and answers were clear. The mathematical communication skills developed have been in accordance with the communicative question sentences, using good and correct language, the sentences used do not cause multiple interpretations, do not use locally applicable language and the question formulation does not contain words that offend students (Sa ' dun Akbar, 2013).

Learning devices that have met the valid requirements are then tested. Small group trials were carried out to see the readability of the developed LKPD. The results of students' responses through practicality questionnaires obtained a value of 89.45% with very practical criteria. Furthermore, the results of the teacher's response through a practical questionnaire obtained a value of 94.00% with very practical criteria.

In this study, the evaluation or effectiveness test phase of learning devices was not carried out because of a national and even global disaster, namely the COVID-19 outbreak. The COVID-19 outbreak has caused agencies that have associations to limit their movements, one of which is educational institutions such as schools. Based on instructions from the central and regional governments, learning in schools is directed through online learning. This causes researchers to be unable to test the level of effectiveness of the learning tools that have been developed.

4. Conclusion

This development research produces learning tools in the form of a syllabus, lesson plans, and LKDP based on the DL model that can facilitate and Mathematical Communication Skills on the Sine and Cosine Rules material. Learning devices are said to be very valid and very practical after going through the validation process by qualified experts and class X students and school teachers to ensure practicality after going through the testing phase, so that the learning tools developed can facilitate the improvement of Mathematical Communication Ability.

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