Development of Learning Tools based on the Discovery Learning Model Integrating 21st Century Skills in Trigonometric Materials in High Schools

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ABSTRACT

This research is based on the limited discovery learning based learning tools that integrate 21st-century skills. The purpose of this study is to produce a valid and practical discovery learning-based of the learning tools that integrate to 21st-century skills in trigonometric material. The development model used the 4D model which consists of the define, design, develop, and disseminate stages. The tools being developed were syllabus, lesson plans, and student worksheets. The instrument used was a validity instrument in the form of a validation sheet, practical instruments in the form of student response questionnaires, and observation sheets. The data collection technique was carried out by distributing questionnaires and observations. The limited trials were conducted on 16 students of class XII MIPA 1 SMA Babussalam Pekanbaru, while practicality trials were carried out in class XI MIPA 2 SMA Babussalam Pekanbaru. The data analysis technique used in this research is quantitative data analysis and qualitative data analysis. From the results of data processing obtained an average syllabus validation result of 3.20; lesson plans 3.36; and student's worksheet 3.43. The average student response questionnaire results in limited trials and field trials were 85.75% and 91.25%, respectively, with the very practical category. The average result of the observation sheet on the implementation of learning activities was 87%. It can be concluded that the learning tools developed are valid and practical.

1. Introduction

Entering the 21st century, challenges in all aspects of life will be even greater. Therefore, reliable and quality human resources are needed. This means that to create reliable and quality human resources, students must be equipped with the

skills needed in the 21st century. Students must have the four skills needed in the 21st century. 21st-century skills are known as 4C's, namely critical thinking, creativity, communication, and collaboration. These four skills are skills that students must have to compete and survive to face global challenges (Afriyanti et al., 2018).

In terms of improving the quality of education in Indonesia, the government has made several policies, one of which is to implement the 2013 Curriculum. The Ministry of Education and Culture No. 20/2016 on Graduates Competency Standards (SKL) explicitly states that graduates must have thinking and acting skills: 1) creative, 2) productive, 3) independent, 4) critical, 5) collaborative, and 6) communicative. This indicates that the goal of education in Indonesia has anticipated the demands of life in the 21st century, namely to create graduates who not only have 4C skills but are also productive and independent.

According to the Ministry of Education and Culture No. 103 of 2014 concerning Learning in Primary and Secondary Education, the content of the 2013 revised edition of the 2013 Curriculum Implementation Plan compiled must integrate four things, namely Strengthening Character Education (PPK), literacy, 21st-century skills or termed as 4C (critical thinking, creativity, communication, and collaboration), and High Order of Thinking Skill (HOTS). The implementation of the 2017 revised edition of the 2013 Curriculum which integrates 21st-century skills requires the pedagogical ability of teachers in designing mathematics learning tools, where these learning devices will be used in the learning process.

According to Susianna (2014), based on 350 questionnaire data from primary, secondary education teachers and lecturers in various regions in Indonesia, it was found that only 35% could explain 21st-century skills and only 17% could design, implement and access learning that emphasized 21st-century skills with a right. 21st-century skills are in line with the 2013 curriculum, so learning tools that integrate 21st-century skills are needed to support the successful implementation of the 2013 curriculum. However, the lack of use and preparation of learning tools that integrate 21st-century skills makes it difficult for teachers to design these learning tools themselves.

In line with Susianna's (2014) research, the results of the analysis of tools conducted by researchers in several high schools also show that the tools used by teachers have not integrated 21st-century skills. Learning sources in the form of textbooks are mathematics books published by the government. For the implementation of learning in the classroom, the teacher has implemented group learning.

Based on the results of interviews with researchers with mathematics teachers at Babussalam High School in Pekanbaru, the teacher had applied group learning. In its implementation, teachers and students use a worksheet published by Intan Pariwara which contains a summary of the material and practice questions. In addition to the Intan Pariwara's worksheet, the teacher also provides the worksheet made by the teacher. The student's worksheet provided is in the form of practice

questions, not steps that must be taken by students in finding concepts so that students do not feel challenged to find concepts from the material being studied.

To help students find their learning concepts, the Discovery learning model is considered capable of transforming teacher-centered learning into student-centered learning. Bruner (in Wulandari et al., 2015) states that learning discovery by itself gives good results in discovery learning. Students try on their own to find solutions to problems and knowledge that are truly meaningful. In applying the discovery learning model the teacher acts as a guide by providing opportunities for students to find and construct their learning concepts. This is following the characteristics of discovery learning proposed by Hosnan (2014) were the main characteristics of learning to find, namely (1) exploring and solving problems to create, combine and generalize knowledge; (2) learner-centered; (3) activities to combine new knowledge and existing knowledge. Also, Putri, et al. (2020) stated that there is a discovery learning based learning device that facilitates teachers and students to develop critical thinking skills of students. Kartika, et al (2020) also stated that the application of the discovery learning model can be an alternative to improve students' understanding of mathematics. So by applying discovery learning, students will further explore their abilities.

One of the subject matter that can help students to find and construct their knowledge is trigonometric material. In Khotimah's research, et al. (2016) it is known that trigonometry is a material that is difficult for students to understand and learning outcomes are still very low. This is because students' understanding is not optimal on this material, students tend to memorize and are not directly involved in the discovery of the concept of trigonometry. Also, Prasojo's research (2016) also states that the difficulty of students in understanding trigonometric material is due to a large number of formulas and the lack of practice for questions about trigonometry by students. In studying trigonometric material, students only accept existing formulas, then memorize them. This makes students accustomed to only receiving and not being trained to construct their knowledge. In studying trigonometric material, students are highly required to have broad thinking skills. By training students to think independently on this material, students will indirectly construct their knowledge. So, with discovery learning based learning tools will help students in constructing their knowledge.

Based on these descriptions, it is necessary to develop a discovery learning based learning tool that integrates 21st-century skills in trigonometric material in high school. The learning tools developed are adapted to the 2013 Curriculum and the stages of discovery learning that integrate 21st-century skills. The learning tools referred to are syllabus, lesson plans, and student worksheet. The Discovery Learning model consists of 5 stages. The five stages are applied to the lesson plan and integrated with 21st-century skills to determine the steps for learning activities and are applied to the student's worksheet to determine the steps to find a concept.

2. Methodology

This type of research was research development or Research and Development (R&D). The R&D model that will be used in this research is 4-D developed by Thiagarajan and Semmel (in Mulyatiningsih, 2014). The 4-D model consisted of 4 stages, namely: Define, Design, Develop, and Disseminate. The test subjects were students of class XI MIPA 2 SMA Babussalam Pekanbaru. The instrument used was a validity instrument in the form of a validation sheet for the syllabus, lesson plans, and student's worksheet; practical instruments in the form of student response questionnaires, and observation sheets. The data collection technique was carried out by validating learning devices to determine the validity and distributing student response questionnaires and observation sheets to determine the practicality of the learning tools.

The data analysis technique used is quantitative data analysis and qualitative data analysis. Quantitative data analysis consisted of data validation and practicality data analysis. Validation data analysis was carried out to determine the validity level of the learning tools developed. This analysis was carried out by determining the average value of each aspect on the validation sheet and the results obtained were adjusted to the validity criteria used. Furthermore, the practicality data analysis of the student response questionnaire and observation sheet aims to determine the practicality level of the learning tools developed by determining the average percentage of the value of each aspect in the student response questionnaire and observation sheet. Furthermore, the results of practicality data analysis will be adjusted to the practicality criteria used. The validity criteria can be seen in Table 1 (Suharsimi Arikunto, 2012).

Table 1. Learning Tool Validity Criteria

Interval	Category
$3{,}25 \leq \bar{x} < 4$	Very Valid
$2{,}50 \leq \bar{x} < 3{,}25$	Valid
$1{,}75 \leq \bar{x} < 2{,}50$	Less Valid
$1{,}00 \leq \bar{x} < 1{,}75$	Not Valid

In Table 1, the average value of the device validation results is symbolized by $\bar{x}$. The product developed is said to be feasible to be tested if the minimum level of validity achieved based on the results of the validator's assessment falls into the valid category. The criteria for practicality can be seen in Table 2 (Sa'dun Akbar, 2013).

Table 2. Practicality Criteria

Interval	Practicality Category
85,01% - 100,00%	Very Practical
70,01% - 85,00%	Practical
50,01% - 70,00%	Less Practical
01,00% - 50,00%	Not practical

According to Akbar (2013), learning tools can be used if the percentage of readability is more than 70%. The product being developed is said to fulfill the practical aspect well if the minimum level of practicality achieved is practical.

3. Results and Discussion

Developed Media

This study uses a 4D development model. At the defined stage, five things must be done, namely preliminary-final analysis, analysis of student characteristics, concept analysis, task analysis, and objective specifications. In the initial analysis, the researchers found the information in the field that will be used as the basis for this study to develop learning tools designed based on learning models that can integrate 21st-century skills. Based on the analysis of mathematics learning tools from four high schools in Pekanbaru city and interviews with 4 mathematics teachers, it is known that teachers have not used learning tools that are following the demands of learning in the 2013 curriculum that integrates 21st-century skills. This is due to the lack of understanding of teachers about 21st-century skills, and limited time in the process of arranging tools.

In the analysis of students, researchers dig deeper into the intellectual abilities of students aged 15-17 years. At that age, the intellectual abilities of adolescents have reached the formal operation phase, according to Piaget's concept. Students are generally able to reason, think broadly, and construct their knowledge. However, this is different from class XI students in general, not all students can reason, think broadly, and construct their knowledge. The difference in the intellectual abilities of different students is used by researchers as a consideration in developing learning tools. Learning models that can help students to reason, think broadly and construct their knowledge so that it helps students to find concepts is a discovery learning model by integrating 21st-century skills.

The next analysis is a concept analysis that contains concepts to be developed and arranged systematically. There are 4 concepts developed, namely the sine rule, the cosine rule, the area of a triangle if you know the two sides and the angle of the triangle, and the area of the triangle if you know the three sides. The results of the concept analysis are used to determine the tasks that will be carried out by students during learning. The defined stage ends with the specification of learning objectives. Learning objectives are determined based on the results of concept analysis and task analysis.

At the design stage, the researcher designed the tools to be developed in the form of a syllabus, lesson plans, student worksheets, student response questionnaires, and learning implementation observation sheets. In the design of the syllabus, the lesson plan, and student's worksheet researchers integrate 21st-century skills in each phase of the discovery learning model.

Furthermore, at the development stage, the researcher developed the design of the learning device, validated and revised the product, and tried out the product. The results of the development of the syllabus are presented in Figure 1.

SILABUS

Nama Sekolah	: SMA …
Mata Pelajaran	: Matematika
Kelas / Semester	: X/II(Genap)
Tahun Pelajaran	: 2019/2020
Materi Pokok	: Aturan sinus dan cosinus
Alokasi Waktu	: 8 x 45 menit

KI 1 :   Menghayati dan mengamalkan ajaran agama yang dianutnya

KI 2 :   Menghayati dan mengamalkan perilaku jujur, disiplin, tanggungjawab, peduli (gotong royong, kerjasama, toleran, damai), santun, responsif dan pro-aktif dan menunjukkan sikap sebagai bagian dari solusi atas berbagai permasalahan dalam berinteraksi secara efektif dengan lingkungan sosial dan alam serta dalam menempatkan diri sebagai cerminan bangsa dalam pergaulan dunia

KI 3 :   Memahami, menerapkan, menganalisis dan mengevaluasi pengetahuan faktual, konseptual, prosedural, dan metakognitif berdasarkan rasa ingin tahunya tentang ilmu pengetahuan, teknologi, seni, budaya, dan humaniora dengan wawasan kemanusiaan, kebangsaan, kenegaraan, dan peradaban terkait penyebab fenomena dan kejadian, serta menerapkan pengetahuan prosedural pada bidang kajian yang spesifik sesuai dengan bakat dan minatnya untuk memecahkan masalah

KI 4 :   Mengolah, menalar, menyaji, dan mencipta dalam ranah konkret dan ranah abstrak terkait dengan pengembangan dari yang dipelajarinya di sekolah secara mandiri serta bertindak secara efektif dan kreatif, dan mampu menggunakan metoda sesuai kaidah keilmuan

Kompetensi Dasar	Materi Pokok/Materi Pembelajaran	Indikator Pencapaian Kompetensi (IPK)	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	1. Aturan sinus	3.9.1 Menyatakan ulang rumus aturan sinus pada segitiga tertentu 3.9.2 Menentukan unsur-unsur suatu segitiga apabila unsur-unsur lain diketahui dengan menggunakan aturan sinus 4.9.1 Menyelesaikan masalah kontekstual yang berkaitan dengan aturan sinus	Melalui diskusi kelompok dengan menerapkan model *Discovery Learning* yang mengintegrasikan keterampilan abad-21 peserta didik melakukan aktivitas-aktivitas berikut: **Fase 1 - Stimulation** a. Mengamati stimulus tentang aturan sinus berkaitan dengan panjang kapal b. Memberikan tanggapan terhadap masalah yang disajikan tentang aturan sinus. **(Komunikasi)** c. Bertanya terkait stimulus yang telah diberikan guru diawal. **(Berpikir kritis)** **Fase 2 - Problem Statement** d. Mengidentifikasi masalah pada LKPD yang diberikan dengan menuliskan apa yang diketahui dan ditanya tentang masalah yang disajikan. **(Berpikir kritis)** e. Membuat rancangan-rancangan langkah penyelesaian masalah dan merumuskan jawaban sementara mengenai permasalahan pada LKPD. **(Berpikir kritis dan**	**Pengetahuan:** **Tes** <u>Tes tertulis</u> bentuk uraian yang terkait dengan aturan sinus **Keterampilan:** <u>Tes tertulis</u> bentuk uraian yang terkait dengan aturan sinus melalui masalah kontekstual	2 x 45 menit	• Buku Teks Pelajaran Matematika kelas X Wajib K-13 • Internet • LKPD

Figure 1. Result of Syllabus Development

In the syllabus, it appears that each phase of discovery learning integrates 21st-century skills. Marked in bold. Furthermore, the development of the lesson plan is based on the syllabus and is developed according to the design in Figure 2.

Figure 2. The Design of The Development of The Lesson Plan

The results of the student's worksheet development are presented in Figure 3 and Figure 4.

Figure 3. Student's Worksheet's Cover

Figure 4. Stimulation Phase in Student's Worksheet

In the student's worksheet, the activities carried out to follow the discovery learning stages that integrate 21st-century skills at each stage. After the product development is carried out, the researcher validates 3 validators who are competent in their fields. The results of the validation were analyzed and then revised according to input and suggestions from the validators. The results of the overall syllabus validation are shown in Table 3 (Researcher Data Processing, 2019).

Table 3. Results of Syllabus Validation

No.	The aspect of Assessment of the SyllabusResults of Syllabus Validation	Score	Criteria
1	Completeness of syllabus components	3,67	Very valid
2	The description of KD in the IPK	3,17	Valid
3	The suitability of the activities carried out with the scientific approach	3,07	Valid
4	The suitability of the activities carried out with the discovery learning model stage	3,11	Valid
5	Availability of learning activities that integrate 21st-century skills	3,08	Valid
6	Appropriateness of learning outcome assessment	3,33	Very valid
7	Time allocation accuracy	3,67	Very valid
8	Suitability of learning resources with competency achievement	3,33	Very valid
	Percentage of average	3,20	
	Criteria	Valid	

The percentage of syllabus validation results is 3.20 with valid criteria. The three validators concluded that the syllabus could be used by revising the completeness of the syllabus identity, using effective sentences, and detailing learning activities. Lesson plans validation results obtained an average value of 3.36 with very valid

criteria. The complete results of the lesson plan validation are shown in Table 4 (Researcher Data Processing, 2019).

Table 4. Lesson Plan Validation Results

No.	Lesson Plan Assessment Aspects	Score				Average
		RPP-1	RPP-2	RPP-3	RPP-4	
1	Completeness of Lesson Plan components	3,67	3,67	3,67	3,67	3,67
2	Clarity of the formulation of the IPK	3,33	3,67	3,67	3,33	3,50
3	Clarity of the formulation of learning objectives	3,17	3,00	3,67	3,33	3,29
4	Suitability and completeness of learning materials	3,27	3,33	3,47	3,47	3,39
5	The suitability of tools, media, and materials as well as learning resources with learning materials	3,33	3,00	2,67	3,67	3,25
6	Preliminary activities	3,13	3,00	3,47	3,47	3,27
7	Suitability of learning activities with the scientific approach	3,00	3,27	3,20	3,33	3,20
8	The suitability of learning activities with the discovery learning model stages	3,50	3,39	3,39	3,39	3,42
9	Availability of learning activities that integrate 21st- century skills	3,09	3,25	3,17	3,17	3,17
10	Appropriateness of learning outcome assessment techniques	3,33	3,67	3,33	3,33	3,42
11	The suitability of the assessment instrument with the indicators of competency achievement	3,33	3,67	3,33	3,33	3,42
	Percentage of average	3,29	3,36	3,37	3,41	3,36
	Criteria	Very Valid	Very Valid	Very Valid	Very Valid	Very Valid

Based on the validation results, the average value for RPP-1 is 3.29; RPP-2, namely 3.36; RPP-3 is 3.37 and RPP-4 is 3.41. The four lesson plans met the very valid criteria. The three validators concluded that the lesson plan can be used with revision. The researcher also made revisions based on the suggestions and input provided by the validator. Some of the suggestions given by the validator were in the form of completeness of lesson plan identities, the suitability of facts on learning materials, the suitability of media, learning tools and materials, and the use of PowerPoint media.

In the student's worksheet the aspects of the assessment are the front page display of the student's worksheet, the learning objectives on the cover of the student's worksheet, the suitability of the learning material, the suitability of the student's worksheet components with the discovery learning model stages, there is an integration of 21st-century skills in each component of the student's worksheet, the suitability of using language and sentences, and suitability. writings, pictures, and displays in the student's worksheet. The results of the student's worksheet validation as a whole are shown in Table 5 (Researcher Data Processing, 2019).

Table 5. Validation Result of Student's Worksheet

No.	LKPD Assessment Aspect	Score				
		LKPD-1	LKPD-2	LKPD-3	LKPD-4	Average
1	LKPD front page display	4,00	4,00	4,00	4,00	4,0
2	Learning objectives on the cover of the LKPD	3,50	3,33	3,50	3,50	3,5
3	Suitability of learning material	3,67	3,33	3,33	3,33	3,4
4	The suitability of the LKPD components with the discovery learning model stages	3,00	3,22	3,06	3,06	3,1
5	There is an integration of 21st-century skills into each component of the LKPD	3,59	3,59	3,33	3,33	3,5
6	Use of LKPD	3,67	3,67	4,00	4,00	3,84
7	The suitability of the use of language and sentences	3,42	3,25	3,17	3,25	3,3
8	Suitability of writing, images, and appearance in LKPD	3,41	3,45	3,22	3,22	3,3
	Percentage of Average	3,53	3,48	3,45	3,46	3,48
	Criteria	Very Valid	Very Valid	Very Valid	Very Valid	Very Valid

Based on the results of the student's worksheet validation, the average score for LKPD-1 was 3.53; LKPD-2 3,48; LKPD-3 3.45, and LKPD-4 3.46. The average value of the validators for the four student's worksheets was 3.48 with very valid criteria. However, the validator provides suggestions for improving student's worksheets such as the student's worksheet cover that must be separated from the core page, providing sufficient space to answer, replacing problems in LKPD-3, and LKPD-4. After all the devices were revised, researchers proceeded to a limited trial. In a limited trial, the researchers tested the student's worksheet on 16 students of class XII MIPA 1 SMA Babussalam Pekanbaru. Limited trials were conducted to see the legibility of the developed student's worksheet. The results of student responses can be seen in Table 6 (Researcher Data Processing, 2019).

Table 6. Results of Student Response in Limited Trial Stage

No.	LKPD	Display and Language Aspects	Presentation Aspects of the Material	Aspects of Learning Activities	Benefits Aspects
1	LKPD-1	80,6%	78,8%	81,4%	83,3%
2	LKPD-2	87%	89%	82,1%	86,3%
3	LKPD-3	90,2%	89,8%	83,4%	91%
4	LKPD-4	88,2%	91%	85,7%	86,7%
	Average	86,5%	87,2%	83,15%	86,95%
	Criteria	Very Practical	Very Practical	Practical	Very Practical

The results of the students' responses showed that all student's worksheets had met the very practical criteria with an average percentage of 85.75%. Overall the implementation of the limited trial ran smoothly. Students look enthusiastic about working on the student's worksheet given by the researcher. Suggestions and input from the results of limited trials become material for revisions for researchers before carrying out field trials. Infield trials, researchers tested the devices in class XI MIPA 2 SMA Babussalam Pekanbaru. The researcher acts as an observer while the teacher acts as a teacher using the developed tools. The results of the students' responses at the field trial stage showed that the student's worksheet tested had met the very practical criteria as shown in Figure 5.
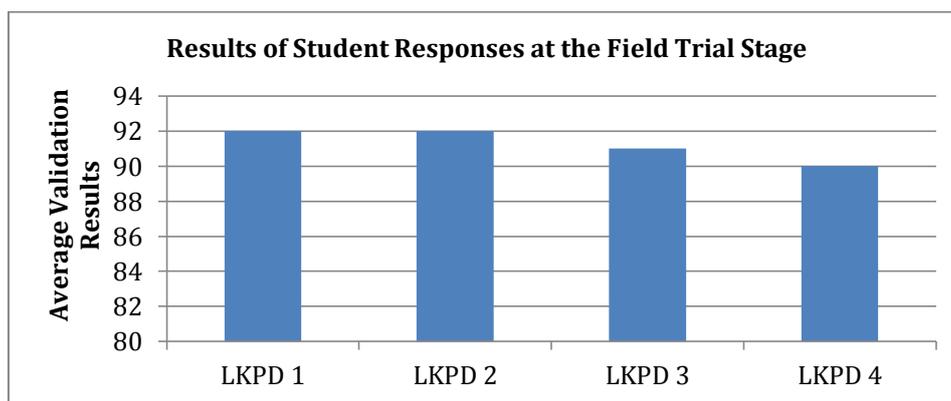

Figure 5. Results of Student Responses at the Field Trial Stage

Based on the results of the observation sheet on the implementation of the learning process, the average value of 4 meetings was 87% with very practical criteria. Learning activities were carried out well in the four meetings.

Discussion

Following the selected development model, this study follows the planned stages according to the 4-D development model stages. The learning tools that have been developed will be assessed for their validity and practicality. At the development stage, the researcher develops learning tools following the initial design.

Validity is carried out to obtain an assessment score and revised suggestions from the validator for the developed device. The aspects assessed in this syllabus consist of two aspects, namely the content aspect and the construction aspect with several assessment indicators. The validator provides an assessment of these two aspects with the following results: the content aspect includes the syllabus identity with the value given by the validator is 3.67 meaning that the syllabus component is following Permendikbud no. 22 of 2016. In the selection of Basic Competence described in Indicators Of Competence Achievement and related to the average basic competence given by the validator is 3.17 with the valid category. This is because the operational verb used in the Indicators Of Competence Achievement has not been measured, so it needs to be improved. In the assessment technique, the score was 3.33, which means that the assessment technique was valid

following the assessment technique with an authentic assessment which was divided into assessments of knowledge and skills.

In this research, however, the assessment still needs improvement in the example of the assessment instrument. For the accuracy of time allocation, the suitability of learning resources, and the achievement of basic competence, values were obtained 3.67 and 3.33, which means that the time allocation set is good enough with the learning material to be delivered in learning, the selected learning resources support the achievement of basic competence and the characteristics of the participant's students. Validators suggest adding other clear references. If using the internet, then include the web address.

The construction aspect which includes learning activities adapted to the steps of the discovery learning model and the scientific approach that integrates 21st-century skills is obtained a score of 3.09 with a valid category. It can be said that these learning activities are following the discovery learning model and the scientific approach that integrates 21st-century skills. However, in learning activities, the integration of 21st-century skills in the discovery learning model must be explained more. In other words, the researcher must connect each stage in the discovery learning model with 21st-century skills. Overall, the syllabus developed by the researcher meets the valid criteria. This was obtained based on the analysis of the validity of the syllabus which reached an average value of 3.20. The syllabus developed is considered to be following the provisions stipulated in Permendikbud number 22 of 2016 concerning Basic and Secondary Education Process Standards with some improvements according to the validator's suggestions.

The validation assessment of the lesson plan is the same as the syllabus which consists of several aspects. The validation value of the lesson plan identity component is 3.67. Based on these scores the lesson plan components are complete and following Permendikbud No. 22 of 2016, only one of the validators suggested including the name of the school. However, because the product produced was not intended for one school, the researchers did not include the name of the school on the lesson plan identity. The clarity of the formulation of competency achievement indicators (Indicators Of Competence Achievement) with basic competencies, the value given is 3.50 or about 87.5%. This means that the Indicators of Competence Achievement described is following basic competencies and measured using operational verbs, but researchers need to improve the editorial of the sentence.

The next aspect is the clarity of the formulation of learning objectives, the value given by the validator is 3.29 or 82.3%, meaning that the learning objectives are following the Indicators Of Competence Achievement that has been determined and contain elements A, B, C, D. The suitability of learning materials containing facts, concepts, principles and procedures obtained a value of 3.39 or 84.75%, which means that the learning materials in the lesson plan are appropriate and contain facts, concepts, principles, and procedures. However, researchers must

improve the facts on each lesson plan with symbols or notations related to the material.

The suitability of the coverage of learning materials with learning tools/media, with learning resources, and the suitability of the coverage of learning materials with the experiences of students, the value is given by the validator was 3.17 or 79.25%. The validator suggests that researchers add the use of media to learning activities. The value given by the validator is included in the valid category, meaning that the learning activities in the lesson plan are good in terms of the suitability of material coverage with learning tools/media, with learning resources and learning activities in the lesson plan can make it easier for students to learn.

In the constructed aspect, including the formulation of learning activities, namely preliminary activities, core activities, and closing activities, are considered very valid with a value of 3.26 or 81.5%. That is, the learning activities arranged are following the discovery learning model stages that integrate 21st-century skills scientifically. However, the validator suggested that the researcher clarify the integration of 21st-century skills in each learning activity and stage of the discovery learning model. For the assessment aspect, the value obtained is 3.42 or 85.5% with a very valid category. This means that the assessment of the lesson plan is following the assessment techniques on the aspects of knowledge and skills. Based on the results of the validator's assessment for the four lesson plans, the lesson plans that the researcher developed met the very valid criteria. This was obtained based on the analysis of the validity of the lesson plans which reached an overall average score of 3.32 or 83% and could be used with revisions.

The lesson plans developed are considered to be following the provisions stipulated in number 22 of 2016 concerning Basic and Secondary Education Process Standards which discuss the principles of lesson plan preparation, including emphasizing the active participation of students and learning activities centered on students. The learning model used in the development of the lesson plan is the discovery learning model, which is learning that prioritizes personal experience through scientific activities (observing, asking questions, collecting information, reasoning, and communicating) which is a student-centered learning process and this model demands more students. active in learning with the teacher acting as a facilitator.

Student's worksheet developed by researchers meets very valid criteria. This was obtained based on the analysis of the validity of the student's worksheet which reached an overall average score of 3.48 or 87%. Overall the student's worksheet developed has fulfilled all aspects of the assessment, but there are several suggestions given by the validator. Some suggestions were given by the validator such as adding space to place students' answers, changing problems in student's worksheets to make it more contextual, and using language so that it does not have multiple meanings. Overall, based on the results of the validation of the syllabus, lesson plans, and student worksheets, the learning tools developed by researchers have met the criteria with a very valid category.

According to Afdareza, et al (2020), the existence of a syllabus and lesson plans can help teachers create an active learning process, while student's worksheet facilitates students to construct their knowledge. After the learning device was revised, the researcher continued with a limited trial of 16 students. In the limited trial phase (small group), what is being tested is the student's worksheets. This trial is to see readability and practicality. The suggestions given by students are also a matter of consideration for researchers to revise student's worksheet. Based on the results obtained from limited group trials, students suggested that the space to write the student's worksheet answers was expanded and the language used in student's worksheet was easier to understand. The average percentage value of student response questionnaires reached 85.75% with the category very practical and suggestions of students are used for improvement before field trials (large group) are carried out.

Field trials were carried out to see the practicality of the Syllabus, lesson plans, and student worksheet. The practicality of the syllabus and lesson plans as seen from the observation sheet on the implementation of learning activities, while the practicality of the student's worksheet is seen from the student response questionnaire. During the learning activities, the researcher as an observer observes the learning activities, then fills the teacher activity observation sheet in applying the discovery learning model that integrates 21st-century skills. Observation of teacher activities is guided by the aspects of opening activities, core activities, and closing activities.

The practicality of the preliminary activity aspects consists of preparing students through greeting, praying, checking attendance, conveying learning objectives, conveying motivation, conveying perceptions, presenting information on learning activities, and forming groups. Based on the observation sheet on the implementation of learning activities, all preliminary activities were carried out in field trials. Teachers also have no trouble organizing students to sit in groups because groups have been formed previously.

The practicality of the aspects of the core activities is adjusted to the stages in the discovery learning model. As for the results of the observation of the implementation of learning activities on field trials, the core activities were carried out well under the guidance of the mathematics subject teacher. However, in the implementation, the timing is still an obstacle, so that sometimes there are still groups that have not finished their presentation materials.

The practicality of the aspects of the closing activities consists of formulating conclusions, giving formative tests, carrying out follow-up activities, and giving assignments, informing learning activity plans, and closing lessons. Based on observations, for the four meetings, all closing activities were carried out. However, at the first and second meetings, the time for giving formative tests took longer.

Based on the practical results from observing teacher activities in applying discovery learning that integrates 21st-century skills, all aspects have been

implemented. However, at the first and second meetings, the timing was still not good. The response of students to student's worksheet was obtained by an average percentage of 28 students, namely 91.5% with the very practical category. Students stated that the developed student's worksheet could help them in learning the sine and cosine rules material. Student's worksheet is easy to understand and students feel happy learning to use student's worksheet because the appearance of student's worksheet is attractive with good cover colors and attractive images. Also, learning by using student's worksheets trains them to find for themselves the concept of the sine rule, the cosine rule, the area of a triangle if two sides are known, and the angle of the flaps and the area of the triangle if the three sides are known.

The existence of a learning device with a discovery learning model can facilitate teachers and students in developing students' thinking skills. The learning activity begins with giving apperception related to the sine and cosine rules material that will be studied by students. In the core, activities are carried out by providing stimuli to students. Students discuss in their respective groups and try to work on activities in the student's worksheet containing activities to be able to solve problems. Students have finished discussing, one group will present the results of the group discussion in front of the class. Students are assisted by the teacher to confirm the correct answer after making a presentation. Finally, students assess learning outcomes by working on formative questions given to them by the teacher.

Overall, from the results of the analysis of the validation value, it can be concluded that the mathematics learning tools in the form of syllabus, lesson plans, and student worksheets on sine and cosine rule material through the application of discovery learning models that integrate 21st-century skills have fulfilled the validity aspect. This is following the opinion of Mulyatiningsih (2014), that the validity of the device is based on the results of expert validation. Based on the observation sheet for the implementation of activities and student response questionnaires and the practicality of using the syllabus, lesson plans, and student worksheet, it is stated that the syllabus, lesson plans, and student worksheet are practical to be used in mathematics learning on sine and cosine rules. This is following the results of research by Ishartono, et al. (2016), that practicality can be seen from the responses of students and class management.

4.   Conclusion

Based on the results of the validation of the syllabus, lesson plan, and student's worksheet, it can be concluded that the learning tools developed have met the valid criteria. This means that all components of the learning device developed have been consistent with each other. Based on the student response questionnaire and observation sheet, it can be concluded that the learning tools developed have met the practical criteria. This means that the device is easy to use by teachers and students and the level of implementation is in a good category and can be implemented properly. The development research conducted has resulted in a

product in the form of a discovery learning based learning tool that integrates 21st-century skills in trigonometric material. The resulting learning tools consisting of a syllabus, lesson plans, and student worksheet are considered valid through the validation process, practical through limited trials and field trials.

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