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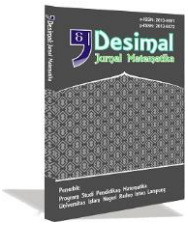

The development of student activity sheet on trigonometric material based on local culture

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ABSTRACT

Mathematics and culture are two different things, but they have a very close relationship in everyday life included in learning activities. Therefore, this research aims to describes the process and results of developing student activity sheets based on local culture on Simple Trigonometric Function Graphs. This research type is research and development. The product developed in this research is a student activity sheet based on local culture on Simple Trigonometric Function Graphics. Student activity sheets are developed based on a modified 4-D development model, which consists of defining, designing, and developing. At the definition stage; conducted a preliminary analysis, student analysis, material analysis, task analysis and specification of learning objectives. At the design stage; The preparation of student activity sheets based on local culture is carried out, selecting the format and then doing the initial design. At the development stage; The design results are validated by the expert and then revised according to the expert's notes. From the results of the research and data analysis conducted by researchers, it was found that the student activity sheets developed had met the criteria for good learning tools because they were declared valid, practical and effective.

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INTRODUCTION

Indonesia is one of the countries that is known for its rich culture. Why? Due to its very strategic geographic location, in this case the location of Indonesia is in the world trade and shipping route. In addition, because Indonesia is an archipelagic country, the people who inhabit certain islands or areas tend to form a culture that is different from the people who inhabit other islands or regions.

According to Joesoef, culture is defined as all the things related to culture. Culture is a lived value system. Cultural review, in this context, is seen from three aspects, namely first, universal culture, which is related to universal values that apply anywhere that develop in line with the development of community life and science or technology. Second, national

culture, namely the values that apply nationally in Indonesian society. Third, local culture that exists in the life of the local community (Hasanuddin, 2017).

Mathematics and culture are two different things, but they have a very close relationship in everyday life. Local culture is a term used to express the relationship between them. According to Rachmawati (2012), local culture is a special method used by a certain cultural group or community in mathematical activities. Where mathematical activities are activities in which there is a process of abstracting from real experiences in everyday life into mathematics or vice versa, including grouping, counting, measuring, designing buildings or tools, making patterns, determining locations, games, explaining, etc. Local culture is an approach that can be used to explain the reality of the relationship between environmental culture and mathematics as a scientific cluster. If you look at other countries, the success of the Japanese and Chinese countries in mathematics learning is because they use local culture in mathematics learning (Achor et al., 2009). Therefore, it is indispensable to introduce the excellence and richness of Indonesian culture to students through the teaching and learning process so that students can find the integration of student cultural identities as a way to promote their national cultural identity to a global context (Mahmud, 2019) and as part of local cultural literacy (Muljani & Sunarto, 2018). One of the ways to improve the quality of the learning process is that the teacher develops instructional media. Theoretically, student worksheets are included in learning media because they can be used to optimize learning outcomes (Pratita et al., 2018).

The development of learning media in the form of student worksheets can help students to improve higher-order thinking skills (Khasyyatillah & Irianti, 2018) and problem solving skills (Amirin & Suparman, 2019), this is indispensable because it is one of the demands of the 21th century.

In general, local community have not realized that they have applied mathematical concepts in their daily lives. For example, in traditional architecture, the Timorese have simply used the concept of 'geometry' in the Lopo construction process. The geometry in question can be seen in Figure 1 below:

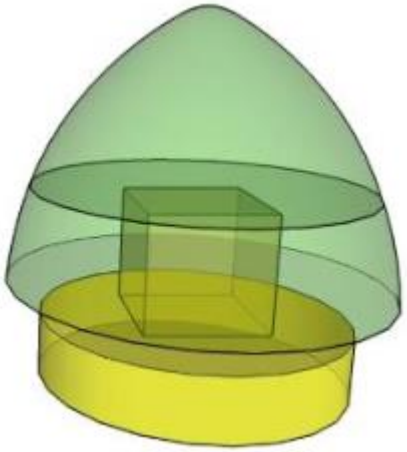


Figure 1. Lopo Axonometri
(Lakapu & Lapenangga, 2019)

Several other construction elements on the Lopo roof (inner circles, outer circles and triangles on the Lopo roof), if it is analyzed mathematically, it shows the concept of real number arrangement. The types of real number arrangement in question include: monotonous decreasing real number arrangement, finite real number arrangement, real number arrangement with a fixed difference and real number arrangement with a non-fixed difference (Lapenangga et al., 2020).

Another mathematical concept that can be learned through culture is Simple Trigonometric Function Graphs. This material is one of the materials studied in the Trigonometry course by Educational Mathematics students in general. Learning media in general is a teaching and learning process device (Aprilia & Supriadi, 2019). One of the learning media that can unite mathematics and culture is Student Worksheets (LKM), through LKM based on

local culture, the concept of Simple Trigonometric Function Graphs can be taught to students.

The following are the opinions of several experts about LKM: (i) Worksheets contain instructions, steps for completing a task (Yolanda, 2019); (ii) LKM is sheets that contain information and instructions to carry out a learning activity such as doing assignments or exercises related to the material being taught to achieve learning objectives (Ernawati et al., 2017); (iii) Mathematics LKM contains questions that help students construct their understanding of the material in mathematics courses (Prastiti et al., 2019).

Several previous researchers who have produced Student Worksheets, among others: Azizahwati and Yasin (2017) develop local wisdom-based Student Worksheets using the 4-D model; Indriani et al. (2019) develop a mathematical activity sheet oriented to a scientific approach using a 4-D development model; Supardi et al. (2018) develop Student Worksheets based on entrepreneurial transaction activities on the two-variable linear equation system material using the ADDIE development model; Restian et al. (2020) develop LKS based on local wisdom in Malang for 4th grade students of elementary school using the ADDIE development model.

In addition, the previous article contained the process of developing a product, among others: Aini et al. (2018) develop teaching materials in the form of handouts through an ethnomathematics approach based on local culture on two-dimensional figure materials using the Borg an Gall development model; Ariskasari and Pratiwi (2019) develop problem solving-based mathematics modules on vector material using the ADDIE development model; Mardiah et al. (2018) develop ethnomathematics based mathematics learning module using inquiry method with the 4-D development model.

Based on researches above, the focus of this research is the development of LKM that integrate the local culture of weaving in East Nusa Tenggara as one of the alternative solutions in learning mathematics, especially on Simple Trigonometric Function Graphs. LKM was chosen because it is more practical and has flexible content because it can be designed according to the goals and conditions of local students. This is the peculiarity of this research. The purpose of this research is to determine the process and results of LKM development based on local culture. The developed LKM is a sheet containing introductory material and assignments that must be completed by students. The development of LKM which is based on local culture, besides being able to improve student learning outcomes, can also improve student pedagogical competence (Ikhsan & SB, 2016) especially for students who are teacher candidates, so it can make the learning process meaningful for students in the future.

METHOD

This research type is research and development. The product developed in this research is the student activity sheets based on local culture on Simple Trigonometric Function Graphs. Researchers adopted three of the four phases in the 4-D development model, namely, defining, designing, and developing, because it was limited by the circumstances when conducting research. At the definition stage; it was conducted a preliminary analysis, student analysis, material analysis, task analysis and specification of learning objectives. At the design stage; The preparation of student activity sheets based on local culture is carried out, selecting the format and then doing the initial design. At the development stage; The design results are

validated by the expert then revised according to the expert's notes, then tested to obtain practicality data and effectiveness data.

This development model was chosen because it is systematic and suitable for developing learning tools. Schematically, the development flow of the 4-D model learning tools according to Thiagarajan, Semmel and Semmel is shown in Figure 2 below.

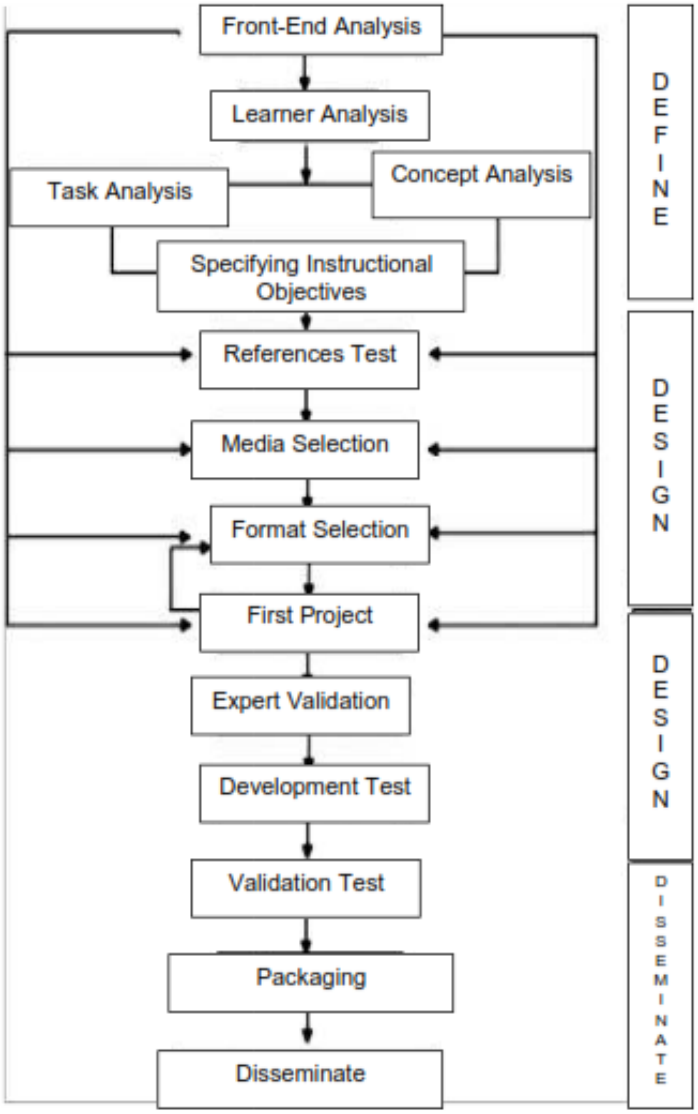


Figure 2. The development flow of the 4-D model learning tools (Lakapu et al., 2017)

Furthermore, these results were tested on the 2nd semester of students of the Mathematics Education Study Program then analyzed and revised according to the results of the analysis.

The success criteria in this research include valid, practical and effectiveness (Santi & Santosa, 2016). The validity of LKS is fulfilled if the results of expert validation from the aspects of format, language and content are in the minimum category for each aspect of the assessment and the validator states that the developed LKM can be applied (either without revision or slight revision). The developed LKM is said to be practical if the assessment of every aspect on the LSLC (Lesson Study for Learning Community)

implementation sheet on the plan, do, see points is at least on enough category and the assessment of every aspect on the student activity observation sheet is at least on moderate criteria. Furthermore, related to effectiveness, the Student Activity Sheet is said to be effective, if the student's response to the Student Activity Sheet is positive and student learning outcomes are achieved in writing by referring to the specified Minimum Completeness Criteria (KKM), namely at least 70% of students get a score of 70.

RESULTS AND DISCUSSION

The product of this research is a valid, practical and effective local culture-based Student Activity Sheet (Tenun NTT). The following is a description of the development process of the Student Activity Sheet that has been developed:

a. The Definition Stage

The preliminary analysis is carried out to determine the basic problem that becomes the background whether a product should be developed or not. The problem that underlies the development of this product is the material concept that is understood by students does not last over a long period of time if it is not studied continuously, so it is necessary to develop a product whose content is related to the daily life of students, so that the material presented can last over a long period of time in their memories.

Student analysis is carried out to examine the characteristics of students so that the products developed are in accordance with student needs. The characteristics of students analyzed in this research are their academic background and knowledge. If it was viewed from the Grade Point Average (GPA), students who are being the research subjects consist of 20% high-ability students, 78% moderate-ability students, and 2% low-ability students. The total number of students who are being the research subjects is as many as 50 people. Graph and trigonometric functions material are a continuation of trigonometry that has been studied previously at the high school level. One of the prerequisite materials is that students are required to have the ability to draw a linear function and quadratic function graph. Based on the experience of teaching Graph and Trigonometric Functions on the previous level students, they still having trouble in drawing graphics related to prerequisite material. In this case, the steps in drawing are not well mastered.

Material analysis is carried out to identify, detailing and systematically arrange the concepts that will be studied by students. The material used in this research is Trigonometric material. The material applied in this research is only limited to the sub-material of Trigonometric Function Graphs. The results of the concept analysis of the Trigonometric Function Graph material that being taught are as follow.

1) Fact: Cartesian diagram, curved line
2) Concepts: definition of graphs and trigonometric functions
3) Principle: some simple trigonometric functions that can be graphed, namely: $y = \sin x$; $y = \cos x$; $y = \tan x$, $0° \leq x \leq 360°$ for 1 turn
4) Procedure
   a) Solving problems related to the graphic function of $y = \sin x$ based on local culture
   b) Solving problems related to the graphic function of $y = \cos x$ based on local culture
   c) Solving problems related to combination of $y = \tan x$ based on local culture.

Task analysis. The task is carried out to identify what students will do in the learning process according to material analysis. Based on the results of the concept analysis, the results of the task analysis are as follows:

1) To be able to solve problems related to the graph of sine, cosine and tangent functions, the steps that must be taken are: (1) Determining the value of x according to the universe of speakers and then determining the value of y according to the predetermined value of x; (2) Draw graphs according to predetermined auxiliary points
2) To be able to determine the graph of the functions that exist in woven fabrics, the steps that must be taken are: (1) Look carefully at the patterns on the woven fabrics presented; (2) Determine the trigonometric function shown in the woven cloth image presented.

The specification of learning objectives is carried out by describing the material analysis and assignment analysis in the form of student behavior. The formulation of learning objectives for Simple Trigonometric Function Graph is as follows:

1. Students can draw a simple trigonometric function graph
2. Students can determine the trigonometric functions in the woven cloth image.

b. The Design Stage

The purpose of this stage is to design student activity sheets based on local culture. This stage begins after the specific learning objectives are set. The design of this local culture-based student activity sheet is adjusted to a predetermined format by paying attention to aspects of content and language.

The LKM format used is as follows: title, learning objectives, instructions, names of group members, and student activity steps. The content of this local culture-based LKM is the steps of student activities that support the achievement of learning objectives, namely after discussing in groups, students can draw simple trigonometric function graph and can determine trigonometric functions that appear on woven fabrics. This LKM is equipped with pictures of woven fabrics and some simple trigonometric functions. The language used in this LKM is a communicative language that encourages students to be able to solve the questions or problems presented.

The following is the initial design result of LKM (before being validated and tested): Page 1, contains the title, learning objectives, instructions, group names and names of group members. Pages 2 to 6, contain student activities in the form of questions and answer places. One of the questions is a matter based on local culture (woven cloth) and students are asked to determine the trigonometric function that appears on the woven cloth.

c. The Development Stage

At this stage, the LKM that has been designed is then validated by experts to see its validity.

The following are the results of the validator's assessment on local culture-based LKM:

Table 1. The Average of The LKM Validation Results

No.	Description	Valuation	
		Validator 1	Validator 2
	Aspect 1: Format		
1	LKM's suitability with learning objectives	4	4
2	Contains LKM components (title, learning objectives, competencies to be achieved, and instructions for completion)	3	3
3	Clarity of presentation order	4	3
4	Font type and size are easy to read	3	4
	Aspect 2: Language		
5	Grammatical correctness (according to EYD)	3	3
6	Using communicative language	3	3
7	Simplicity of sentence structure used	3	4
8	Clarity of instructions and directions	3	4
9	Encourage student interest in learning	3	3
	Aspect 3: Content		
10	The right content or material in the LKM	4	3
11	The relationship between the content of the LKM taught with the real situation of students based on local culture	4	4
12	The ability to encourage students to make connections between the student knowledge and its application in everyday life	3	3

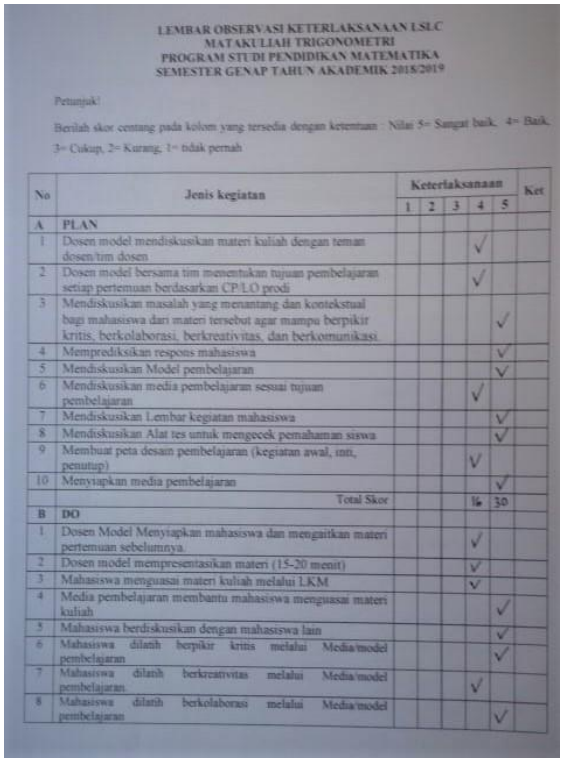
The following are the assessment criteria used, those are:

1 : means "very less"
2 : means "less"
3 : means "good"
4 : means "very good"

Based on table 1 and according to the description of the assessment, the local-based developed LKM is **valid**, because for every aspect of the assessment that is assessed to be at least in good category and both validators state that LKM can be used with a slight revision according to the notes given. Some notes provided by the validator, namely: (1) add introductory material regarding the trigonometric function graphs at the beginning of the LKM; (2) it is necessary to add time allocation to the identity section.

After the researchers analyzed and made revisions according to expert comments, then the LKM was tested in the real life to see the practicality and effectiveness of the tool. The practicality data in this research are data on the LSLC implementation and observations of student activities.

The following are the observation results of the LSLC implementation using the LKM that have been developed from the plan, do, and see stages.



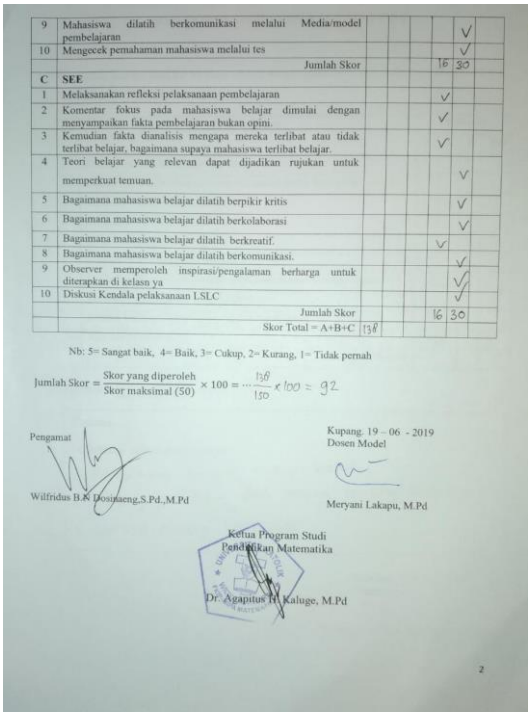
LEMBAR OBSERVASI KETERLAKSANAAN LSLC
MATAKULIAH TRIGONOMETRI
PROGRAM STUDI PENDIDIKAN MATEMATIKA
SEMESTER GENAP TAHUN AKADEMIK 2018/2019

Petunjuk!

Berilah skor centang pada kolom yang tersedia dengan ketentuan : Nilai 5= Sangat baik, 4= Baik, 3= Cukup, 2= Kurang, 1= tidak pernah

No	Jenis kegiatan	Keterlaksanaan					Ket
		1	2	3	4	5	
A	PLAN						
1	Dosen model mendiskusikan materi kuliah dengan teman dosen/tim dosen				√		
2	Dosen model bersama tim menentukan tujuan pembelajaran setiap pertemuan berdasarkan CP/LO prodi				√		
3	Mendiskusikan masalah yang menantang dan kontekstual bagi mahasiswa dari materi tersebut agar mampu berpikir kritis, berkolaborasi, berkreativitas, dan berkomunikasi					√	
4	Memprediksikan respons mahasiswa					√	
5	Mendiskusikan Model pembelajaran					√	
6	Mendiskusikan media pembelajaran sesuai tujuan pembelajaran				√		
7	Mendiskusikan Lembar kegiatan mahasiswa					√	
8	Mendiskusikan Alat tes untuk mengecek pemahaman siswa					√	
9	Membuat peta desain pembelajaran (kegiatan awal, inti, penutup)				√		
10	Menyiapkan media pembelajaran					√	
	Total Skor				16	30	
B	DO						
1	Dosen Model Menyiapkan mahasiswa dan mengaitkan materi pertemuan sebelumnya				√		
2	Dosen model mempresentasikan materi (15-20 menit)				√		
3	Mahasiswa menguasai materi kuliah melalui LKM				√		
4	Media pembelajaran membantu mahasiswa menguasai materi kuliah					√	
5	Mahasiswa berdiskusikan dengan mahasiswa lain					√	
6	Mahasiswa dilatih berpikir kritis melalui Media/model pembelajaran					√	
7	Mahasiswa dilatih berkreativitas melalui Media/model pembelajaran				√		
8	Mahasiswa dilatih berkolaborasi melalui Media/model pembelajaran					√	

Figure 3. Page 1 Observation Sheet of LSLC Implementation



9	Mahasiswa dilatih berkomunikasi melalui Media/model pembelajaran					√	
10	Mengecek pemahaman mahasiswa melalui tes					√	
	Jumlah Skor				16	30	
C	SEE						
1	Melaksanakan refleksi pelaksanaan pembelajaran				√		
2	Komentar fokus pada mahasiswa belajar dimulai dengan menyampaikan fakta pembelajaran bukan opini.				√		
3	Kemudian fakta dianalisis mengapa mereka terlibat atau tidak terlibat belajar, bagaimana supaya mahasiswa terlibat belajar.				√		
4	Teori belajar yang relevan dapat dijadikan rujukan untuk memperkuat temuan.					√	
5	Bagaimana mahasiswa belajar dilatih berpikir kritis					√	
6	Bagaimana mahasiswa belajar dilatih berkolaborasi					√	
7	Bagaimana mahasiswa belajar dilatih berkreatif.				√		
8	Bagaimana mahasiswa belajar dilatih berkomunikasi.					√	
9	Observer memperoleh inspirasi/pengalaman berharga untuk diterapkan di kelasn ya					√	
10	Diskusi Kendala pelaksanaan LSLC					√	
	Jumlah Skor				16	30	
	Skor Total = A+B+C	138					

Nb: 5= Sangat baik, 4= Baik, 3= Cukup, 2= Kurang, 1= Tidak pernah

Jumlah Skor = $\frac{\text{Skor yang diperoleh}}{\text{Skor maksimal (50)}} \times 100 = \frac{138}{150} \times 100 = 92$

Pengamat

Wilfridus B.N. Dosinaeng,S.Pd.,M.Pd

Kupang, 19 – 06 - 2019
Dosen Model

Meryani Lakapu, M.Pd

Ketua Program Studi
Pendidikan Matematika

Dr. Agapitus D. Kaluge, M.Pd

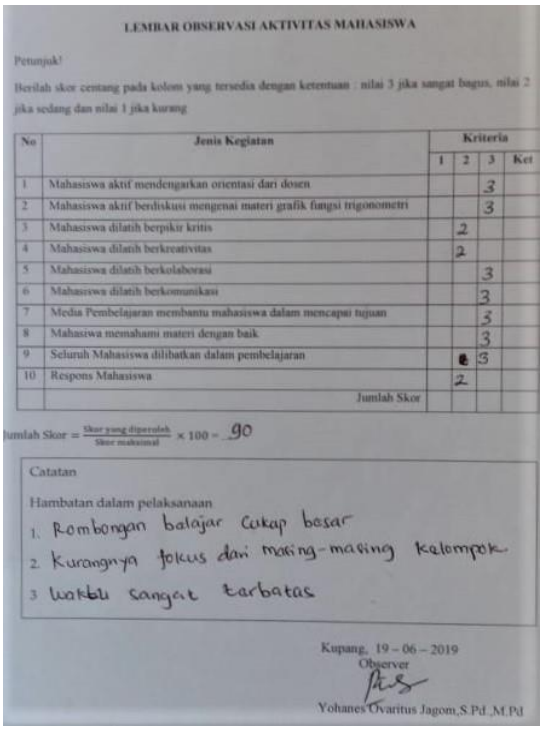
Figure 4. Page 2 Observation Sheet of LSLC Implementation

The following are the assessment criteria used, those are:

91 - 100 : means "very good"
76 - 90 : means "good"
61 - 75 : means "enough"
51 - 60 : means "medium"
≤ 50 : means "less"

Based on Figure 3, Figure 4 and in accordance with the description of the assessment above, the LSLC using a local-based developed LKM can be carried out very well, because for each aspect of the assessment that is assessed on the plan, do and see at least in the good category.

The following are the results of student activity observations:



LEMBAR OBSERVASI AKTIVITAS MAHASISWA

Petunjuk!

Berilah skor centang pada kolom yang tersedia dengan ketentuan : nilai 3 jika sangat bagus, nilai 2 jika sedang dan nilai 1 jika kurang

No	Jenis Kegiatan	Kriteria			
		1	2	3	Ket
1	Mahasiswa aktif mendengarkan orientasi dari dosen			3	
2	Mahasiswa aktif berdiskusi mengenai materi grafik fungsi trigonometri			3	
3	Mahasiswa dilatih berpikir kritis		2		
4	Mahasiswa dilatih berkreativitas		2		
5	Mahasiswa dilatih berkolaborasi			3	
6	Mahasiswa dilatih berkomunikasi			3	
7	Media Pembelajaran membantu mahasiswa dalam mencapai tujuan			3	
8	Mahasiswa memahami materi dengan baik			3	
9	Seluruh Mahasiswa dilibatkan dalam pembelajaran		2	3	
10	Respons Mahasiswa		2		
	Jumlah Skor				

Jumlah Skor = $\frac{\text{Skor yang diperoleh}}{\text{Skor maksimal}} \times 100 = 90$

Catatan

Hambatan dalam pelaksanaan

1. Rombongan belajar cukup besar
2. Kurangnya fokus dari masing-masing kelompok
3. Waktu sangat terbatas

Kupang, 19 – 06 – 2019
Observer

Yohanes Ovaritus Jagom,S.Pd.,M.Pd

Figure 5. Student Observation Sheet

Based on Figure 3 and according to the description of the assessment above, it is concluded that students are actively involved in spelling out local-based LKM,

because for each aspect of the assessment is at least in the moderate category.

Based on the conclusions drawn from the LSLC implementation data and student activity observation data, it can be concluded that the learning tools that have been developed are **practical**.

The effectiveness data in this research are in the form of student response data to the Student Activity Sheet and student learning outcomes data.

The following are the results of the student response questionnaire in doing the developed LKM: After the lecturer gave the LKM, 90% were motivated to read it; 88% of students can understand the learning objectives listed in the LKM; 92% of students can understand the language used in LKM; 74% of students are interested in the appearance / writing of the LKM; 80% of students said that LKM can help them to understand Simple Trigonometric Function Graphs; 76% of students said that the LKM used was new to them / different from usual; and 78% of students are interested in the further learning for other materials (using local-based LKM).

Based on the explanation and defined criteria that students have a positive response, if the number of students who respond choose the question "Yes" at least 60% for each aspect being asked, then the student response to the LKM can be said to be positive.

Student learning outcomes data are taken from the results of the LKM. Classical completeness requirements are achieved if the minimum $\left(\frac{1}{2}n + 1\right)$ groups of n groups of students who get a minimum LKM score of 65. Based on the data on the results of the LKM, it is obtained that there are 8 out of 10 groups who get a score above 65 so it can be concluded that completeness of student learning outcomes is classically achieved.

Based on the conclusions taken from the response data and student learning outcome data, it can be concluded that the learning tools that have been developed are **effective**.

The following is a recapitulation of the achievement of the learning tools criteria in the trial class:

Table 2. The Achievement of The Learning Tools Criteria in The Trial Class

Aspect	Information
Expert Validation	Valid
Expert Advice	Can be used with minor revisions
LSLC	Fulfilled (at least good)
Student Activities	Fulfilled (active)
Student Response	Fulfilled (positive)
Learning Outcomes Test	Fulfilled (complete)

Based on Table 2, the results of LKM based on local culture on the Simple Trigonometric Function Graph is in good quality, because it meets the criteria of validity, practicality and effectiveness. This is equal to the product criteria that have been produced previously through previous research, namely (Azizahwati & Yasin, 2017); (Indriani et al., 2019); (Supardi et al., 2018) and (Restian et al., 2020). The product criteria in question are products that are "feasible" to be used as a learning resource for students. This is concluded based on the aspects of validation and expert advice, LSCL, activities, responses and student learning outcomes tests.

CONCLUSIONS AND SUGGESTIONS

Based on the results of the research and data analysis conducted by researchers, the developed student activity sheet had met the criteria for a good learning tools because it is declared valid, practical and effective. The Student Activity Sheet is said to be valid, because every aspect assessed by the expert is at least in good category and the expert states that the developed LKM can be used with a few revisions. The developed LKM is said to be practical because every aspect of the assessment on the LSLC is at least in

good category and students are active in using the LKM. Student Activity Sheets are said to be effective, because students respond positively and student learning outcomes are classically complete.

This developed local culture-based worksheet can be distributed to a wider scope so that more students learn about existing local wisdom, besides that, it can foster interest in learning in students.

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