Digital Receipt

This receipt acknowledges that Turnitin received your paper. Below you will find the receipt information regarding your submission.

The first page of your submissions is displayed below.

Submission author:	Zainal Abidin
Assignment title:	Artikel
Submission title:	Development of student worksheets on ethnomathematics-b...
File name:	Husna_2021_J._Phys.__Conf._Ser._1882_012071.pdf
File size:	629.28K
Page count:	9
Word count:	4,422
Character count:	25,363
Submission date:	25-Nov-2021 03:57PM (UTC+0700)
Submission ID:	1712548576

Journal of Physics: Conference Series

PAPER · OPEN ACCESS

Development of student worksheets on ethnomathematics-based trigonometry through Project-Based Learning models

To cite this article: N Husna *et al* 2021 *J. Phys.: Conf. Ser.* **1882** 012071

View the article online for updates and enhancements.

You may also like

- Exploration of ethnomathematics on the lampisung nagia indigenous peoples
R Hermanto, Wahyudin and E Nurlaelah
- Realistic mathematics learning based on the ethnomathematics in Bengkulu to improve students' cognitive level
W Widada, D Herawaty and A N M T Lubis
- Development of teaching materials of elementary school student with a scientific approach characterized by ethnomathematics
S Lena, N Netriwati and I Suryanita

IOP ebooks™

Bringing together innovative digital publishing with leading authors from the global scientific community.

Start exploring the collection–download the first chapter of every title for free.

This content was downloaded from IP address 182.3.9.219 on 25/10/2021 at 18:59

Development of student worksheets on ethnomathematics-based trigonometry through Project-Based Learning models

by Zainal Abidin

Development of student worksheets on ethnomathematics-based trigonometry through Project-Based Learning models

Development of student worksheets on ethnomathematics-based trigonometry through Project-Based Learning models

N Husna[1], Saminan[1] and Z Abidin[1]

[1] Mathematics Education Department, University of Syiah Kuala, Teuku Nyak Arief St. No. 441 Kopelma Darussalam, Syiah Kuala District, Banda Aceh City, Aceh 23111, Indonesia

E-mail: saminanismail58@gmail.com

Abstract. One of Indonesia Curriculum 2013 learning principles is learning that prioritizes culture and the empowerment of students. The culture of certain societies contains a mathematical concept known as ethnomathematics. One of the many mathematical materials found in ethnomathematics is trigonometry. However, in reality, students have difficulty mastery of trigonometry material. So far, ethnomathematics-based learning tools in Aceh traditional houses as an application of trigonometry are not yet available. Therefore, it is necessary to develop ethnomathematics-based learning tools. This study aims to develop an ethnomathematics-based trigonometry project worksheet through the Project-Based Learning model that met the valid criteria. This research refers to the Plomp development model, which consists of preliminary research and a prototyping stage. This study's instruments were needs analysis sheets, validation sheets, observation sheets, and response questionnaires. The results showed that the developed Project Worksheet met the valid criteria because all validators stated that the project worksheet was fit for use.

1. Introduction

Learning tools are one of the supports that must be considered in the learning process. One form of learning tools discussed in this study is a project worksheet. It is in line with the Regulation of the Minister of Education and Culture (Permendikbud) in 2016, which states that every educator is required to prepare a complete and systematic Learning Plan so that learning takes place in an interactive, inspiring, fun, and independent manner [1]. Permendikbud No. 81 A, part IV states that academic unit study materials contain local learning content related to local potential and uniqueness to shape learners' understanding. Developing local content is carried out as an independent subject or integrated into other subjects [2].

Trigonometry is one of the materials studied in Senior High School. Trigonometry material is reflected in life icons [3], one of which is the civilization of Acehnese cultural life, namely the building of Acehnese traditional houses, that is Krong Bade. The construction of traditional Aceh houses made by craftsmen has applied the building's equilibrium, which stands firmly due to the correct relationship between the angles associated with the sides' length [4].

The culture of a particular society which contains mathematical concepts is called ethnomathematics. One of the cultural-based mathematics learning approaches is ethnomathematics [5, 6]. Ethnomathematics grows and develops in Indonesia as an alternative in developing mathematics learning tools, which still tend

to be conventional and less contextual [7]. In general, ethnomathematics is a science studied with culture or cultural anthropology from mathematics and mathematics education that develops following society's development [8].

PjBL (Project Based Learning) is a learning model that uses broad problems to collect and integrate new knowledge based on experiences in real activities. It is hoped that PjBL becomes a useful model for engaging students with relevant learning so that participant's students gain meaningful understanding [9]. Trigonometry is a material with a relationship from high school senior education to the next level of education, so senior high school students need to master trigonometry material [10]. Based on the preliminary study, the learning process was not involved contextually in understanding trigonometry. Students' understanding was meaningless and had an impact on low test scores [11]. The literature analysis results show that educators have not used Acehnese culture and traditional houses (*Krong Bade*) as applications of trigonometry material. One of the principles of Curriculum 2013 is learning that prioritizes culture (civilization) and students' empowerment. Ethnomathematics and culturally relevant pedagogy-based approaches to mathematics curriculum are intended to make school mathematics relevant and meaningful as well as to promote the overall quality of students' educational experience [12]. Literature reviews and interviews with several Acehnese educators found no project assignment to discuss Acehnese traditional houses as a tangible form of comparative trigonometry in right triangles. Therefore, it is necessary to develop ethnomathematics-based learning tools in Acehnese traditional houses to apply trigonometry.

Responding to problems that arise in Indonesian mathematics education, it is necessary to improve students' trigonometry skills through ethnomathematics-based project worksheets through the PjBL model. It is expected to help teachers provide learning tools on trigonometry material.

2. Methods

The development model used is the Plomp model. One of the reasons researchers chose the Plomp model is that the development of the Plomp model is more suitable for research on the development of learning tools in education. At the preliminary research stage, the Plomp model does not limit the needs analysis required by researchers. Because researchers need to carry out needs, context analyses, and literature reviews, develop conceptual and theoretical frameworks to determine the needs of learning tools that need to be developed. So that Plomp's initial investigation step can obtain more detailed information on needs. Plomp and Nieveen stated three development research stages: preliminary research, prototyping, and assessment phases [13]. In the legibility test, the researcher chose six students of year 10 of the Senior High School 2 in Sigli who were not the field trial class subjects, with varying abilities. The selection of Senior High School 2 Sigli was based on considering that students tend to still live in traditional Aceh houses.

In the preliminary research phase, the activities were carried out to gather information about the importance of ethnomathematics-based learning through the PjBL model on trigonometry material. The instrument used at this stage is a needs analysis sheet consisting of Curriculum 2013 analysis for Senior High School of year 10, concept analysis in developing ethnomathematics-based trigonometry project worksheet through the PjBL model, analysis of existing tools, analysis of project assignments in the Curriculum 2013 book, analysis of literature and learning sources, analysis of school situations and conditions, and analysis of users. At this stage, the data obtained are teacher comments or statements, which are then processed descriptively.

In the prototyping stage, the activities were designing an ethnomathematics-based project worksheet through the PjBL model on trigonometry material. At this stage, prototype one is produced, which is ready to be validated. Next, the readability test was conducted by several students. In this phase, the data required is in the form of information from experts to repair the designed device. Therefore, the instrument used in this phase is the project worksheet validation sheet.

At the prototyping stage, the data obtained are comments and suggestions from the project worksheet validator that has been designed. The data is then analyzed in the following steps. 1) Reducing data by

grouping validator answers based on each component in the validation sheet, 2) Simplifying the results of validation by the validators by presenting the data in the form of narrative text, and 3) Concluding the validity of the project worksheet designed using the 2013 Nieveen criteria [13].

The validity test is used to determine whether the student worksheet developed by the researcher follows the ethnomathematical-based stages' characteristics through the PjBL model. Six validators carried out the project worksheet validation. The detailed criteria are adjusted to the level of validity of the developed project worksheet, namely: 1) At least five of the six validators state that the project worksheet is based on a robust theoretical foundation, 2) At least five of the six validators say that the project worksheet is consistent, 3) The test results show that the developed project worksheet components are interrelated. Four aspects are the target of validation, namely the feasibility of the content through 8 question items, the feasibility of language through 5 questions, the feasibility of presenting the material through 3 questions, and the feasibility of graphics through 4 questions.

3. Result and Discussion

This study's results are described based on the Plomp & Nieveen 2013 development model consisting of preliminary research and a prototyping stage.

3.1. Preliminary Research

3.1.1. Analysis of Curriculum 2013 for Senior High School Mathematics Year 10. The analysis of the Permendiknas document no. 22 of 2016 shows that Curriculum 2013 uses a scientific approach with one of the learning strategies, Project-Based Learning. Based on the curriculum coordinators' information at several schools in Banda Aceh and Sigli, they implemented the 2017 revised edition of the Curriculum 2013. The results of curriculum analysis and literature review show that students are prepared to follow the flow of globalization and various issues related to environmental and cultural issues [14]. Culture-based learning is a form of mathematics learning innovation that is in line with the times [5, 15]

3.1.2. Analysis of Concept in Developing Learning Tools. The prerequisite materials that must be mastered by students are the Pythagorean Theorem and similarities [16]. Based on the questionnaires and interviews with teachers in several schools, it shows that teachers have not taught the concept of trigonometry comparisons in ethnomathematics-based right triangles, namely in the Aceh traditional house application.

3.1.3. Analysis of Existing Tools. Mathematics learning tools that are arranged and taught so far have not integrated with other disciplines. Teachers tend to apply the Problem Based Learning or Discovery Learning model for trigonometry comparison material on right triangles but have not used the PjBL model.

3.1.4. Analysis of Project Tasks in the Curriculum 2013 Package Book Revised in 2017. The analysis of project assignments in the Curriculum 2013 textbook revised in 2017 contained no project assignments for trigonometry comparison material on right triangles. However, it is included in the trigonometry function graph material, and there were no ethnomathematics-based project tasks.

3.1.5. Analysis of Literature and Learning Resources for Trigonometry and Ethnomathematics. The literature and learning resources analysis shows that the teacher's book's trigonometry concept in Curriculum 2013 is relevant to the scientific approach. Besides, students' textbooks have also displayed pictures of Acehnese traditional houses as an applied form of ethnomathematics-based trigonometry.

3.1.6. Analysis of Situation and Condition at School. Observations made by researchers in several schools indicate that the learning facilities are adequate and feasible. However, learning field case studies with a cultural approach has never been carried out, especially on trigonometry comparison material. A learning aid in the form of a clinometer is available. However, it has never been used for the mathematics learning process on trigonometry comparison material.

3.1.7. Analysis of User. The user needs analysis results to show that the teacher responds positively by approving and supporting the designed worksheet. The teacher hopes that with the ethnomathematics-based project worksheet, students can better understand and love their culture. Through the PjBL model, students can learn to be more independent and meaningful.

3.2. Prototyping Stage

Project worksheet is given to students for two meetings with six activities and one meeting for presentations. At the first meeting, on page 1 is a group identity sheet and page 2 contains a project assignment to assess earthquake-resistant Aceh traditional houses that are around the students' residence. Page 3 includes a brief introduction to the traditional Aceh house and how to use the clinometer. Pages 4-6 contain activity 1 to determine questions, provide ideas, compile a schedule, and the person in charge of the project task.

Pages 8-13 contain two activities. This activity is given to students outside of learning hours to prepare and ease project work at the second meeting. Page 8 includes directions for finding material to provide for the next meeting. Pages 9-13 contain activities two and three for students to find, view, and select Acehnese traditional houses, prepare tools and materials and write down the steps for carrying out project assignments. Page 13 contains input for preparing tools and materials when conducting the interview process.

The second meeting contains three activities. At this meeting, students look for and process data to complete project tasks. Pages 14-17 have four activities that require students to answer and provide calculations related to project assignments. Students give answers whether the Aceh traditional house is earthquake resistant. Students also calculate the traditional Aceh house's height, many foundations (feet of tameh), many poles, and height. Then, to measure *tulak angen*, students are first directed to calculate the height *diri*, length of *gaseu gantung*, and *bara linteung*. On page 17, there is activity five, which contains interview questions to the speakers. Page 18 includes shortcomings, strengths, and suggestions for project tasks to be done. At the next meeting, students present the results of their project.

Figure 1. Front view of *Tulak Angen*, the traditional Aceh house

Figure 2. The inside of a traditional Aceh house containing a height *diri*, length of *gaseu gantung*, and *bara linteung*.

In figure 2, the inside of an Aceh traditional house shows the exact relationship between the angle (*bara linteung*) and (*gaseu gantung*) associated with the sides' length. The red arrow indicates the height of *diri*, the blue arrow indicates *gaseu gantung*, and the yellow arrow indicates *bara linteung*.

3.3. Stage I Validation

The project worksheet validator consists of six people. Three validator experts consisting of material experts, ethnomathematics experts, and mathematics education lecturers. (Validator-1, Validator-2, and Validator-3), Three validator practitioners consist of experienced teachers, model teachers, and colleagues who have carried out relevant research through the PjBL model (Validator-4, Validator-5, and Validator-6). The following are the results of the validation at stage I.

The general assessment by two validators stated that the project worksheet was feasible to use without revision. Three validators said that the project worksheet was possible to be used with a few modifications. One validator noted that it was feasible to be used with revisions. Based on the validator's assessment, it can be concluded that the project worksheet designed is not valid. Thus, the project worksheet still needs improvement.

The improvement of results of the analysis of the project worksheet validation's feasibility is part of the PjBL model syntax. The clinometer must be taught the appropriateness of the time allocation, clarify the sketch again by predicting the student's answer model and make sure that its understanding is easy to apply. Improving the analysis results of the feasibility of the project worksheet language validation is the use of grammar that must be communicative. Then, improving the analysis results of the validation of the feasibility of presenting project worksheet materials clarifies indicators and emphasizes the project worksheet's information. Improving the feasibility validation analysis of project worksheet graphics strengthens a more attractive design on each page.

3.4. Stage II Validation

The researcher revises the comments and suggestions from the validator, and the result is called prototype II. Comments on the project worksheet's design received many suggestions from the editorial staff, how to distribute assignments to students, directions for activities and exciting innovations, and the use of clinometers and sketches that must be clarified. The validator's general assessment is declared fit for use without revision, so it can be concluded that the project worksheet designed is valid.

3.5. Readability Test

The readability test was carried out after the researcher revised the learning device according to the validator's comments and suggestions. The learning device was declared valid and became a prototype III. Prototype III was then tested on students' year 10 in Senior High School-scale as many as six people who had studied trigonometry comparisons in right triangles and were chosen randomly.

Based on the readability test results, it was found that there were sentences that were less effective and needed an explanation regarding how the clinometer worked.

The inculcation of character values through the PjBL model has also begun to be embedded in students' behaviour. It can be seen in students' enthusiasm for learning through students' positive response in carrying out project activities.

3.6. Results of the Development of Ethnomatematic based Trigonometry through the PjBL Model

The developed project worksheet contains one project task for three meetings. Project worksheet is given in stages in each session, consisting of 6 activities, divided into three parts.

The first meeting consists of 1 activity. Students are asked to ask questions, submit ideas, and compile a schedule for planning activities to be carried out, and the person in charge of each activity. Thus, the first meeting's learning objectives were to determine fundamental questions and solution strategies and compile a schedule to solve problems related to trigonometry comparisons in right triangles.

At the end of the first learning meeting, students are given a second pre-meeting project worksheet independently outside the learning hours, which has two activities. On the start page of the second pre-meeting project worksheet, students are asked to prepare reading materials and tools to facilitate the work on the second meeting of project worksheet project tasks in the field. Activity 1 at the pre-meeting project worksheet allows students to look for sources to be interviewed at the second meeting. The interviewees are expected to know that the Aceh traditional house is one of the earthquake-resistant houses and is an application of trigonometry. Activity 2 is to pay attention to several Acehnese traditional houses around students' residence and choose Aceh traditional house to be studied. Students are asked to write down the tools & materials used in the second meeting and write down the field's work steps. Therefore, this second pre-meetings learning objective was to create a mathematical model with the Acehnese traditional house's help related to the right triangle's trigonometry ratio.

At the second meeting, students completed a project worksheet, which consisted of 3 activities. The second meeting was the core of the project's task: to examine Acehnese traditional houses in the students' areas, earthquake-resistant houses. The measurement process is carried out by comparing trigonometry, using a clinometer as a measuring tool for height, and interviewing informants. Furthermore, students are asked to present the findings at the second project worksheet meeting. At the last meeting, all groups presented bills, and the results were carried out on one project task. Thus, the last meeting's learning objective was to create a mathematical model with the Acehnese traditional house's help related to trigonometry comparisons in a right triangle.

3.7. Discussion

The aspects studied in this study were to obtain valid criteria. Validation activities are significant for assessing the feasibility of the basics of the concepts or theories used. The validation stage is carried out in two aspects: expert validation and legibility test [17]. Validation activities are carried out by a validator consisting of six experts, namely material experts, ethnomathematics, mathematics education lecturers, experienced teachers, model teachers, and peers who carry out relevant research through the PjBL model.

The validator provides assessment in the form of comments and suggestions on project worksheets designed to determine the project worksheet's strengths and weaknesses. Based on the content feasibility validation results, all validators stated that the questions or assignments given were by the competency indicators. The project assignment given to the project worksheet is ethnomathematics-based and can develop students'

mathematical skills on trigonometry [16], especially developing character skills and love for the country, said the validator 4. The project worksheet designed follows the PjBL model's syntax and can add insight to students, especially insight into their own regional culture [12]. The given project worksheet is following the time allocation. Still, the three validators argued that it was not enough time because of the large number of assignments. It would be better if the assignment bills were more detailed for time fit, hoping that the project assignment could fulfil all the assessment rubrics. Validators 1, 2, 3, and 4 argue that to facilitate the application of project assignments, clarify the sketch again, and it is better if students' answer models are made in advance. Also, pay attention to the understanding of students who are the subjects of this study [18].

Based on the language feasibility validation results, the project worksheet is designed to have correct grammar with slight improvements, simplicity of sentence structure, and clear instructions and directions. The designed project worksheet already uses communicative language with a few revisions. Three validators argued that there was some ambiguous language for the sketch section and a slight revision of the sketch questions. Based on the results of the validation analysis of the material presentation feasibility, it was found that all validators stated that the designed project worksheet was presented in order. The project worksheet is designed to have clear objectives (indicators) to be achieved, and the information provided is clear and complete. Validator 1 suggested that additional emphasis was needed to use the clinometer to not be wrong during the measurement process. Validators offer suggestions that the use and availability of project assignment aids (clinometers) need to be anticipated so that the students' field research process can run smoothly. In this case, students are actively involved in learning to expand students' abilities and meaningful [12].

Based on the results of the graphical feasibility validation analysis, it was found that the worksheet project was designed attractively, the layout arrangement was appropriate, the type and font size were also appropriate. The design used for each page is attractive. The validator suggested that project assignments be designed more clearly and in detail to help students understand and apply the comparative science of trigonometry to the right triangle. It aims to make students as active learning actors able to construct their knowledge [17].

The validator recommends trigonometry project worksheet ethnomathematics-based through the researcher's PjBL model as a learning tool. It is feasible to be applied in classroom learning. In other words, the validation process has been carried out by the validators states that the products in this study are categorized as valid. The next step is the readability test.

The legibility test results show that students still have difficulty interpreting the sketch. Some of the calculation commands and sentence structure in the activities were also not well understood by students. Two of the six students were still unfamiliar with the terms given in the Acehnese language, such as measuring *tulak wind*. It happens because the other four students already have initial knowledge obtained from their socio-cultural environment [19]. Some of the difficulties found by students were found to be the basis for improvement by researchers. The ethnomathematics approach aims to make mathematics learning more relevant and meaningful for students [12]. Thus, the next step is for the researcher to conduct field trials to test the developed project worksheet's practicality and effectiveness.

4. Conclusion

Based on the needs analysis and the interviews, it was found that the learning steps were systematically ordered, the trigonometry material needed to be studied contextually (ethnomathematics-based or linked to everyday life). In the analysis of existing tools, it is known that the teacher has never seen and used ethnomathematics-based trigonometry learning tools through the PjBL model. Learning field case studies conducted outside the school building with a cultural approach has never been carried out, especially in the trigonometry comparison material.

Based on the discussion that has been previously explained, the following conclusions can be drawn. This study produces a product in the form of an ethnomathematics-based trigonometry project worksheet through the PjBL model. It has met the valid criteria because all validators stated that it was suitable for use.

References

[1] Permendikbud 2016 *Journal of Chemical Information and Modeling*
[2] Kementerian Pendidikan dan Kebudayaan 2014 *Materi pelatihan guru implementasi Kurikulum 2013 tahun ajaran 2014/2015 mata pelajaran matematika SMP/MTs* (Jakarta: Kementerian Pendidikan dan Kebudayaan)
[3] Jingga A A, Mardiyana and Setiawan R 2017 *Jurnal Pendidikan Matematika dan Matematika* **1** 48-62
[4] Sinaga B, Sinambela P, Sitanggang A K, Hutapea T A, Manullang S, Sinaga L P and Simanjorang M 2017 *Matematika Senior High School/MA/SMK/MAK Kelas X* (Jakarta: Balitbang, Kemendikbud)
[5] Marsigit, Condromukti R, Setiana D S and Hardiarti S 2018 *Prosiding Seminar Nasional Etnomatnesia* pp 1-19
[6] Wahyuni A, Tias A A W and Sani B 2013 *Prosiding Jurusan Pendidikan Matematika FMIPA UNY* pp 113–8
[7] Fitriatien S R 2019 *Jurnal Ilmiah Pendidikan Matematika* **4** 53-64
[8] Ambrosio U D 2014 *FLM Publishing Association* ***5*** 44–8
[9] Capraro R, Capraro M M, & Morgan J R 2019 *STEM Project-Based Learning An integrated science, technology, engineering, and mathematics (STEM) approach (*Rotterdam: Sense Publisher)
[10] Abidin Z 2012 *Jurnal Ilmiah DIDAKTIKA* ***XIII*** 183–96
[11] Puspendik 2018 *Laporan Hasil Ujian Nasional* (Indonesia: Jakarta)
[12] Rosa M and Orey D C 2010 *Revista Horizontes* **28** 19-31
[13] Plomp T and Nieveen N 2013 *An Introductional to Educational Design Research* (Enschede: SLO)
[14] Firman H 2016 *Prosiding Seminar Nasional Kimia dan Pembelajarannya* **7** 1-7
[15] Fajriah E 2018 *PRISENIOR HIGH SCHOOL PRISMA Prosiding Seminar Nasional Matematika* 1 pp 114-9
[16] Putra R W Y and Anggraini R 2016 *Al-Jabar: Jurnal Pendidikan Matematika* **7** 39–47
[17] Rahayu D S 2016 *Jurnal Pendidikan dan Pembelajaran Matematika* **2** 14-24
[18] Rosa M and Orey D C 2011 *Revista Latinoamericana de Etnomatematica* **4** 32-54
[19] Sugiyono 2015 *Metode penelitian dan pengembangan (*Bandung: Alfabeta)
[20] Sirate F S 2012 *Lentera Indonesia* **15** 41-54

Development of student worksheets on ethnomathematics-based trigonometry through Project-Based Learning models

ORIGINALITY REPORT

14%	12%	8%	5%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

MATCH ALL SOURCES (ONLY SELECTED SOURCE PRINTED)

6%

★ N R N Peni, T Baba. "Consideration of curriculum approaches of employing ethnomathematics in mathematics classroom", Journal of Physics: Conference Series, 2019

Publication

Exclude quotes	On	Exclude matches	< 25 words
Exclude bibliography	On		

Development of student worksheets on ethnomathematics-based trigonometry through Project-Based Learning models

GRADEMARK REPORT

FINAL GRADE

/0

GENERAL COMMENTS

Instructor

PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

PAGE 9