JPI, Vol 7 No 2 Oktober 2018
ISSN: 2541-7207 DOI : 10.23887/jpi-undiksha.v7i2.13742

The Development of Curved Side Constructions Learning Media Involving Problem Solving Capability and Local Culture Wisdom

Andi Saparuddin Nur[1], Oswaldus Dadi[2]
[1,2] Universitas Musamus
email: andisaparuddin@unmus.ac.id[1], oswald.dadi@gmail.com[2]

Abstract

The purpose of this study was to obtain a learning tool of curved side room learning materials based problem-solving ability and local cultural wisdom for students of class IX Junior High School in Merauke City that meet valid, effective, and practical criteria. This type of research is development research with 4D model design (Define, Designed, Develop, Disseminate). The subjects of the study were the students of class IX of SMP Negeri 9 Merauke. The resulting learning tools were tested and experimented using the posttest only control group design. The result of this research is obtained learning tools of curved side room learning-based problem-solving ability and local cultural wisdom that fulfill valid, practical, and effective criteria. Learning tools produced are student books, Student Activity Sheets (LKS), and Lesson Plans (RPP). The results of the device test show the students' mathematics problem-solving ability is better than the control class with an average score of 61.81 versus 52.57. Hypothesis testing using independent sample t-test shows Ho is rejected with the t count value of 3.049 which means that problem-solving ability using local culture learning tools is better using conventional learning devices.

Keywords: *Curved Side Constructions; Problem Solving; Local Culture Wisdom*

1. Introduction

Problem-solving is an important instrument that must be mastered by students in learning mathematics at the junior high school level. However, the results of research conducted by international institutions still place Indonesia in a less than satisfactory position. Based on the latest data released by the PISA in 2015, it placed Indonesia in position 63 of 70 countries for students' mathematical abilities aged 15 years (OECD, 2016). The results of the study also showed that only 15.3% of students in Indonesia believed that mastering mathematics had an impact on their future. This shows the need to improve the learning process in the classroom so students feel close to mathematics and able to use it in everyday life. In line with the results of the study, the results of the SMP / MTs National Examination (UN) in 2016 for the average value of mathematics subjects experienced a correction of 6.04 points from the previous year (Kemdikbud, 2016). Some of the factors that caused the decline in mathematical values from the UN SMP/ MTs in 2016 were the increasing composition of questions involving high-level thinking skills, one of which was problem-solving ability.

Mathematics as a compulsory subject at every level of education has an important role in the lives of students. The application of mathematical concepts in various cultural practices is the basis that mathematics is very close to human life. However, the development of mathematics learning at school still does not touch on the cultural aspects inherent in students (Saragih, Napitupulu, Fauzi, 2017). Mathematics learning is still very dependent on textbooks published nationally so that students do not feel the closeness of mathematical concepts to the context of their cultural life.

The cultural approach is an aspect that needs to be emphasized in learning mathematics in the 21st century. The rapid development of technology has caused the world of education to need to restore the nuances of local wisdom in learning various concepts, especially in the field of mathematics. According to Akib (2016), the approach of local culture in mathematics learning can lead to a high sense of empathy, caring, and self-confidence because students feel the presence of local wisdom that has grown long in the community in the classroom. This is also in line with what was expressed by Cheriani et al (2017) that the local cultural

ISSN: 2541-7207 DOI : 10.23887/jpi-undiksha.v7i2.13742

approach had a good impact on students 'attitudes and behaviors in learning mathematics and increased students' confidence in presenting in class.

The development of mathematical learning tools, especially the material that builds curved side space that involves the wisdom of local culture is very appropriate in developing students' mathematical problem-solving abilities (Nur & Palobo, 2017). Mathematical problem solving is a process that uses the strengths and benefits of mathematics to solve problems that are also models of solution discovery through the stages of problem-solving (Nuha et al., 2014: 189). According to Bailey (Muhassanah et al., 2014: 55) problem solving is a combination of brilliant ideas to form new combinations of ideas. According to Novotna (2014) heuristic strategies in solving mathematical problems can be developed in various ways, some of which are using similarities in nature or analogies of objects in the surrounding environment. This means that problem solving can be started from various activities that become cultural results in a community.

Mathematical learning based on local culture is designed to focus on the material that is related to the regional culture where students come from (Rohaeti, 2011). Learning based on local culture makes the material substance obtained from the activities of the local community. This results in students' understanding that learning mathematics is very closely related to problem-solving in everyday life. For example, the shape of the curved side space that has long been known in the community and becomes the identity of the local wisdom of the people of Merauke is noken, honai, tifa, musamus, and many others.

Local culture-based mathematics learning focuses on creating a dynamic learning atmosphere, which recognizes the existence of students with all their backgrounds, experiences, and initial knowledge, which allows students to freely ask questions, make mistakes, explore, and draw conclusions about various things in life (Rohaeti, 2011). Through learning based on local culture, context becomes more important than content so students are no longer charged with several concepts that are not related to their daily lives. The teacher becomes more proactive and plays various roles not only as a source of information but also as a mediator and facilitator. The learning process provides the widest possible space for students to develop problems and determine the most appropriate solution to solve them. The teacher must be democratic and respect the opinions of students if there is a mistake, the teacher provides constructive corrections so students learn the parts that need to be corrected. Based on the description, the researcher asked research questions, namely; "How is the development of material learning devices curved side constructions that meet the criteria of valid, effective and practical based on problem-solving skills and wisdom of the local culture?"

2. Method

This type of research is development research which includes the development of learning devices, namely (1) Learning Implementation Plans, (2) Student Activity Sheets, (3) Student Books, and (4) Assessment Instruments. The development research design used was adapted from the 4D model. This research was conducted in SMP Negeri 9 Merauke from October to December 2017. The subjects of this study were grade IX students of SMP Negeri 9 Merauke.

This development research procedure refers to the 4D model which consists of four stages, namely: (1) the definition phase, (2) the design stage, (3) the development stage, and (4) the deployment stage. At the development stage, it consists of expert validation, simulation, and device testing. The implementation of the learning device trial uses the experimental design of the posttest control group design. Meanwhile, at the stage of dissemination of the final product produced was distributed to all grade IX students of SMP Negeri 9 Merauke.

The instrument of data collection in this study is in the form of an assessment to assess the product produced which includes the assessment of learning device instruments for validity criteria, practicality, and effectiveness. Data collection techniques in this study used to test techniques, and non-test. The test technique is used to collect data on the results of problem-solving abilities to build up the curvilinear side of the students, while the non-test

ISSN: 2541-7207 DOI : 10.23887/jpi-undiksha.v7i2.13742

technique is in the form of observation activities related to the development process of learning devices involving local cultural wisdom.

Analysis of the data in this study relates to the process of obtaining learning devices of material to construct curved side spaces that involve the ability to solve problems and wisdom of local cultures that meet the criteria of validity, practicality, and effectiveness. The validity assessment criteria follow the following rating conversion guidelines (Azwar, 2013):

Table 1. Assessment criteria

No	Value Range	Criteria
1	$X \leq M_i - 1{,}5\ SD_i$	Very Low
2	$M_i - 1{,}5\ SD_i < X \leq M_i - 0{,}5\ SD_i$	Low
3	$M_i - 0{,}5\ SD_i < X \leq M_i + 0{,}5\ SD_i$	Medium
4	$M_i + 0{,}5\ SD_i < X \leq M_i + 1{,}5\ SD_i$	High
5	$M_i + 1{,}5\ SD_i < X$	Very High

For the assessment of practical criteria, use the percentage analysis by comparing the number of positive responses with the total number of responses. Learning tools are declared practical if the percentage of responses is ≥75%. Meanwhile, the effective criteria used were comparative analysis of the posttest results of the problem-solving abilities of the control class and experimental class using the independent sample t-test. Learning devices involving the ability to solve problems and the wisdom of local culture in the material to construct curved side spaces were declared effective if statistically, the results of the experimental class posttest were better than the control class.

3. Results and Discussion

3.1 Defining Phase

At the defining stage, a needs analysis is carried out by exploring the characteristics of students, materials, and tasks needed in the implementation of the learning process. The choice of material in the construction of curved side spaces was developed by considering aspects of local wisdom that developed in the community. The concept of constructing curved side spaces was formulated to be accommodative to local cultural structures such as using honai, tifa, musamus, and noken attributes.

Design Phase

At the design stage, researchers compile learning devices that will be used in the development and research stages. Learning tools developed are worksheets, lesson plans, and student books. The learning device becomes a prototype or initial draft of the development of learning devices in this study. Learning devices are prepared by taking into account the analysis of requirements and prerequisites needed to produce the desired product. Therefore, the researcher adjusts the learning device produced with the time allocation for the construction of tube space, cone, and sphere, students' socio-cultural factors, and the efficiency of the use of instructional media.

The stage of designing learning devices is carried out through 4 stages, namely; (1) preparation of tests, (2) media selection, (3) format selection, and (4) initial draft. Tests are prepared using a subjective form or description with emphasis on material problem-solving abilities to construct curved side spaces. Problems that are the focus are objects related to local culture, for example, analyzing the surface area of a tifa, calculating the volume of honai rooms, and so on. The media chosen in the study is an LCD projector with consideration of the characteristics of students who are more interested in the material is delivered in audiovisual.

3.2 Development Phase

The stage of developing learning devices is done by validating, simulating, and testing the RPP, student worksheets, and student books. Validation is carried out by three experts who are competent in their respective fields. The validator consists of experts in the field of mathematics, experts in the field of Indonesian language, as well as experts in the field of school mathematics learning.

The component developed by the researcher in drafting RPP, LKS, and student books is the concept of local culture assimilated into the substance of the material to construct curved side spaces. Many researchers focus on a variety of problems that are directly related to people's daily practices. As an example; (1) the problem of determining tube elements is related to the characteristics possessed by tifa, (2) the problem of determining the cone volume associated with musamus buildings, and (3) the problem of determining the half-sphere surface area using the roof concept in the honai.

From the results of the validator's assessment, it is known that the level of validation of the learning device is in a valid or very valid category (Figure 1). The validator's comments on the learning device emphasize more on the aspects of student activity, readability of the problem, and the accuracy of using terms containing local culture. The researcher constructs the form of the problem to be more varied by adding a column of student activities in determining the formula for the surface area of the ball using the coconut shell.

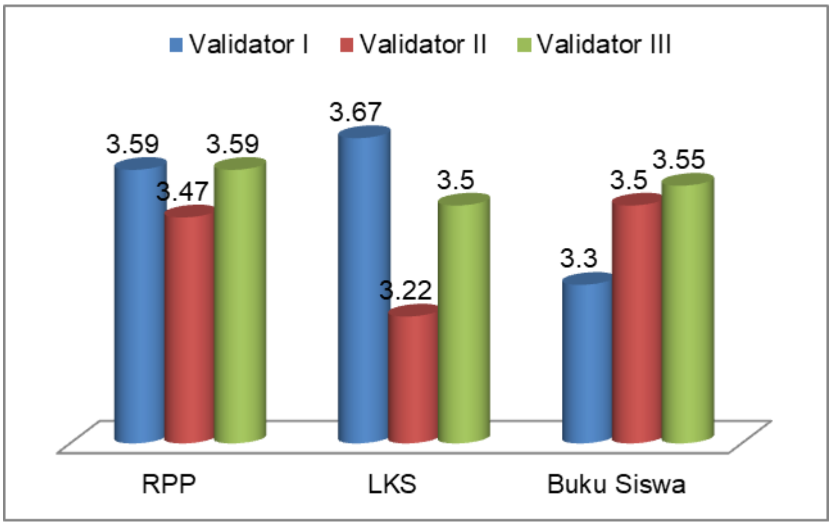

Figure 1. Validator assessment results on Learning Devices

Furthermore, to find out the practicality level of RPP, student worksheets, and student books a device simulation was carried out involving teachers and class IX students of Merauke Middle School 9. Students are given a questionnaire to determine the practicality level of student worksheets and student books while the teacher is given a questionnaire to determine the practicality of lesson plans. The results of student responses showed that as many as 85% of students gave a positive response in assessing the practicality of worksheets which included the allocation of processing time, difficulty level, and readability of the problem. Nevertheless, some students are still having difficulty in solving problems related to the elements of building a cone and sphere. Students need a better understanding of the different concepts of the cusp and corner points on cones and the concept of sides on a ball. Based on the assessment of the response of the students, the researcher revised the LKS using the properties of the musamus to explain the cone elements and the honai roof in explaining the elements of the ball. For student books, 77% give a positive assessment of the exposure and readability of material substance. The addition of some features in the student book which contains interesting facts about the application of the concept of building curved side spaces in indigenous Papuans can attract students' attention such as the cone-like house of musamus, a tifa musical instrument in the form of two symmetrical cones, and noken which is a traditional bag Papua that resembles a tube. While the assessment of the practicality of the lesson plan, the teacher gave a positive response of 82% of the total

ISSN: 2541-7207 DOI : 10.23887/jpi-undiksha.v7i2.13742

response items. The revision made in the RPP is to draw up a plan for the core activities using groups of 3-4 people. It is considered necessary so that students with low and moderate abilities can be guided by highly skilled friends. Thus, the learning process is no longer dominated by several students, and problems can be solved together.

After a device simulation, a device trial was then carried out using the experimental research design posttest only control group design. The device testing was carried out 3 times face-to-face and 1 time the learning outcomes test. The material used is to build curved side space in the experimental class and the control class and the learning process refers to the KTSP curriculum. The learning process in the experimental class and control during face-to-face runs following the RPP guidelines, but there are differences in student and teacher activities during the learning process takes place (Table 2).

Table 2. Comparison of experimental and control class learning activities

No	Components of learning activities	Experimental class	Control class
1.	Instructional impact		
	a. Control of learning	Learning is arranged by the teacher by involving students through group discussion activities.	Learning is fully regulated by the teacher.
	b. Mastery of media/ learning resources	Students use student books, student worksheets, and understand examples of questions through presentations.	Students obtain information from teachers and textbooks.
	c. Problem-solving skill	Gradually trained students solve various examples of problems related to building curved side spaces.	Students are only able to solve routine questions and occasionally solve non-routine questions.
	d. Learning activities	Dominated the process of discussion, presentation, and question and answer.	Dominated by the lecture method from the teacher.
2.	Impact accompaniment		
	a. Ability to cooperate	Students in groups help each other in solving problems.	More competitive, students always want to be the best.
	b. Freedom of expression	The opinions of each student accommodation and directed if still wrong.	There are only right or wrong answers.
	c. Attitude together	Students are in a learning community that supports a sense of togetherness.	More individuals or if in groups only limited to the similarity of *gank*ing.
3.	Social system		
	a. Class management model	Classes are arranged with group models with chairs arranged face to face.	The arrangement of student chairs is arranged neatly facing the teacher's desk and blackboard.
	b. Teacher and student interaction	Dialogical discussion, mutual questioning, and openness of opinion occurred.	More nomological interactions, less feedback from students, and monotonous.
	c. Interaction between students	Students discuss each other, respect each other's opinions, and provide opportunities to learn together.	Not much discussion, more dominated by certain students in learning activities.
4.	Principle of reaction		
	a. Perception of learning	More understanding of the meaning of mathematical learning and its application in daily life,	More interested in vertical mathematical concepts and looking at the material

ISSN: 2541-7207 DOI : 10.23887/jpi-undiksha.v7i2.13742

No	Components of learning activities	Experimental class	Control class
		especially related to the application of local cultural activities.	studied with its application separately.
	b. Reflection of learning	Students have a deep curiosity about the objects of local culture associated with building curved side spaces.	Students have a curiosity about how to solve questions and practice forms in the textbook.
	c. Form of assessment	Assessment is carried out thoroughly both from the cognitive, affective, and psychomotor aspects.	Assessment is carried out limited to cognitive aspects.

Differences in classroom learning activities have an impact on students' mathematical problem-solving abilities. This can be seen in students' mastery in solving problems based on indicators understanding problems, planning problem solving, carrying out problem-solving, and re-examining the solutions obtained.

Figure 2 shows five items of posttest questions that were completed by students in the control class and experimental class. Each item shows an indicator of mastery of problem-solving abilities. In general, students in the experimental class are better able to solve problems for each question given. However, in question number 4 more students in the control class were able to understand the problem by writing what was asked and known compared to students in the experimental class. This is because students in the experimental class solve the most recent problem number 4 so that the completion process is not paying attention to the steps to solving the problem properly. Nevertheless, students in the experimental class who understood question number 4 were better able to plan and solve problems than students in the control class.

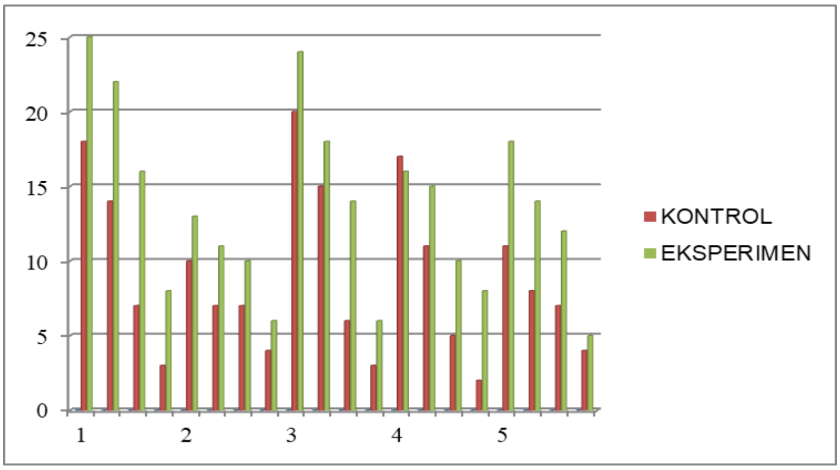

Figure 2. Comparison of the Ability to Solve Mathematical Problems in the Control and Experiment Groups

Based on Figure 2, it can be identified that question number 2 is the problem students feel is most difficult to solve compared to the other questions. This can be seen from the low number of students who can understand problems both in the control class and in the experimental class. In question number 2, most students had difficulty understanding the honai image which consisted of building a tube chamber and half a ball. Students are more likely to think intuitively in understanding problems and not analyzing each part of the picture. Meanwhile, questions number 1 and number 3 are quite easily understood by students because they are more procedural. In problem number 1 each part of the tube and cone element is known so that students only need knowledge of the surface area to build up the

ISSN: 2541-7207 DOI : 10.23887/jpi-undiksha.v7i2.13742

curved side space to be able to solve the problem. While in problem number 3 students are asked to calculate the volume of the known musamus height and radius of the base so that by knowing the cone volume formula, students can solve the problem.

Based on the results of the analysis in table 2. it can be seen that the problem-solving abilities of students in the experimental class are better than students in the control class. The average value of mathematical problem-solving abilities of the experimental class students is greater than the median/mode value which indicates that most of the values of the experimental class students are above the average value. Meanwhile, the average value of mathematical problem-solving abilities for control class students is smaller than the mode value which indicates that most grades of control class students are below the average value.

Table 3. Descriptive statistics from the posttest of the experimental class and the control class

Statistical measure	Class	
	Experiment	Control
Number of samples	27	28
Minimum	40	35
Maximum	82	75
Average	61,81	52,57
Median	60	53,5
Modus	60	40
Standard deviation	11,55	10,93

Next, to find out the difference in the problem-solving ability of the experimental class compared to the control class was tested by the hypothesis. The sentence of the hypothesis tested is written statistically as follows:

$H_0: \mu_E \leq \mu_K \quad Vs \quad H_1: \mu_E > \mu_K$

$\mu_E =$ parameter average problem-solving ability posttest experimental class.

$\mu_K =$ parameter average problem-solving ability posttest control class.

The inferential statistical technique used to test the hypothesis is an independent sample t-test. However, before testing hypotheses, a prerequisite analysis is carried out, namely, testing the normality of the data using the Kolmogorov Smirnov test. The results of the analysis are shown in Table 4.

Table 4. The results of the normality test of the experimental class and the control class

Class	Statistic	p-value	Conclusion
Experiment	0,627	0,826	Normal
Control	0,556	0,917	Normal

After the assumption of normality is fulfilled, the next step is to test the hypothesis using an independent sample t-test. The results of the analysis are shown in Table 5.

Table 5. Hypothesis Test

F		t		Conclusion
Statistic	p-value	Statistic	p-value	
0,204	0,653	3,049	0,004	Ho rejected

Table 5 shows that the two data groups (experimental class and control class) have homogeneous variances with F count values and p-value> 0.05. Because it has an equal variance, the two groups of data can then be compared using the independent sample t-test polled variance. The test results obtained statistically t value greater than t table with a marked p-value <0.05. This gives the conclusion that H0 is rejected and H1 is accepted.

ISSN: 2541-7207 DOI : 10.23887/jpi-undiksha.v7i2.13742

Thus, there is insufficient evidence to say that mathematical problem-solving abilities using local culture-based tools for building curved side space are lower or equal to mathematical problem-solving abilities taught using conventional learning tools. Therefore, statistically, it can be said that the learning devices that have been developed have a positive influence on students' mathematical problem-solving abilities in the matter of curved side constructions.

3.3 Dissemination Phase

In the dissemination stage, final product learning devices have been produced in the form of RPP, LKS, and student books that meet the criteria of valid, effective, and practical. Next, the researchers distributed the final product to be used in class IX students of SMP Negeri 9 Merauke as learning devices.

Learning mathematics is not solely on factual and procedural understanding. However, mathematics is very much related to the application of daily activities, especially the culture of society (Rohaeti, 2011). The principle of horizontal mathematics is an effective means of rediscovering mathematical values contained in activities that are very important in mathematics education. The Marine tribe, which is an indigenous tribe in the City of Merauke, has a different value from the cultural aspects produced. Some works are produced such as musical instruments that use cones, forms of animation, or other forms that are in the culture of society. However, if the concept used cannot be distorted between understanding mathematical concepts as a system and cultural results as a form of local wisdom. Therefore, mathematics learning that influences the concept of culture becomes very effective for students.

The development of mathematical learning tools based on local culture is a means of activating and fostering a positive attitude towards mathematics. Students in the experimental class showed a sense of acceptance better in learning mathematics than the control class. Students are more enthusiastic in solving problems given to LKS with a sense of self-confidence, mutual respect, and responsibility compared to being given training in conventional textbooks. This is in line with the opinion of Cheriani et al (2015) which states that problem-based learning by incorporating elements of local culture fosters mutual respect, responsibility, empathy, and cultivating shame in oneself. Meanwhile, according to Akib (2016) mentioning the inclusion of local cultural values can foster positive interactions between students and students, students with teachers, and student acceptance of the mathematical concepts learned.

The ability to solve mathematical problems is one of the goals of mathematics learning. Students need to understand the benefits of learning mathematics by knowing the form of application in everyday life. Through local culture-based learning, students become more aware of the relevance of mathematical concepts to solving problems that occur in society. The local cultural context becomes an effective means of generating motivation for students to learn mathematics. Based on the results of activities and mathematical problem-solving abilities students can be seen that the class that applies local culture-based learning devices is better than classes with conventional learning devices. This is in line with the opinion of Saragih et al (2017) which states that learning devices with material content based on local culture can foster high-level thinking skills of students. Mathematical problem solving as one of the aspects of high-level thinking is needed by students in applying mathematical concepts, especially those that are directly related to their application in society.

Mathematics learning based on local culture accompanied by various activities also supports mathematical problem-solving abilities. Through the instructions for implementing the learning given on the LKS each meeting fosters student motivation in solving problems. According to Pambudiarso et al (2016) learning with an activity approach can guide students to solve mathematical problems better than if they only get information from textbooks. In line with this, according to Nuha et al (2014), the geometric problem-solving abilities of students who have high character elements and creative performance are better than students who have low character and creative performance categories. This shows that problem-solving ability is not only determined by mastery of concepts but also influenced by character attitudes and the ability to work creatively. The results in this study also showed that students' cognitive abilities did not become the only factor in the success of students in solving problems given. There were 3 students in the control class who at the time of the daily test before the material constructing the curved side of the room obtained a high score obtained a score below the KKM at the posttest. In addition, learning in the experimental class by applying the concept of local culture fosters the character of discipline and responsibility in students. Different in the control class whose learning process is carried out conventionally is not able to activate the student as a whole.

4. Conclusions and suggestions

In this study, learning tools based on local culture were obtained by involving students' mathematical problem-solving abilities in the material to construct curved side spaces that met the criteria of valid, effective, and practical. By using this learning tool, students' mathematical problem-solving skills are better. In addition, students will be able to develop a sense of sensitivity, acceptance, and appreciation of mathematical values in everyday life. Therefore, teachers are expected to always associate the concept of local culture with the substance of relevant learning material.

References

Akib, I. 2016. The Local Cultural Values In The Interaction of Mathematics Learning at School. *IOSR-Journal of Mathematics*. Vol.12, No. 4. Hal 24-28

Azwar, S. 2013. *Tes Prestasi*. Yogyakarta: Pustaka Pelajar.

Cheriani. Mahmud, A. Tahmir, S. Manda, D. Dirawan, G. 2015. *Problem Based Learning Buginese Cultural Knowledge Model Case Study: Teaching Mathematics at Junior High School.* Vol. 8, No. 4. Hal 104-110.

Kemdikbud. 2016. Indeks Integritas UN SMP/MTs Meningkat. *Dipresentasikan dalam Konferensi Pers Pemaparan Hasil Ujian Nasional SMP 2016 di Jakarta Pada Tanggal 10 Juni 2016*.

Muhassanah, N. Sujadi, I. Riyadi. 2014. Analisis Keterampilan Geometri Siswa Dalam Memecahkan Masalah Geometri Berdasarkan Tingkat Berpikir Van Hiele*. Jurnal Elektronik Pembelajaran Matematika*. Vol. 2, No. 1. Hal 54-66.

Novotna, J, et.al. 2014. Problem Solving In School Mathematics Based On Heuristic Strategies. *ERIES Journal*. Vol. 7, No. 1, Hal 1-6.

Nur, A.S & Palobo, M. 2017. Pengaruh Penerapan Pendekatan Kontekstual Berbasis Budaya Lokal Terhadap Kemampuan Pemecahan Masalah Matematika. *Jurnal Aksioma*. Vol. 6, No. 1. Hal 1-14.

Nuha, M.A. Suhito. Masrukan. 2014. Analisis kemampuan pemecahan masalah geometri dan karakter Siswa Kelas VIII Melalui Pembelajaran Model 4K. *Jurnal Kreano*. Vol. 5, No. 2. Hal 188-194.

OECD. 2016. PISA 2015 Results in Focus.

Pambudiarso, R.B. Mariani, S. Prabowo, A. 2016. Komparasi Kemampuan Pemecahan Masalah Materi Geometri antara Model SPS dan Model SPS dengan Hands on Activity. *Jurnal Kreano*. Vol. 7, No. 1. Hal 1-9.

Rohaeti, E. 2011. Transformasi Budaya Melalui Pembelajaran Matematika Bermakna di Sekolah. *Jurnal Pengajaran MIPA*, Vol. 16, No. 1. Hal 139-147.

Saragih, S. Napitupulu, E.E. Fauzi, A. 2017. Developing Learning Model Based on Local Culture and Instrument for Mathematical Higher Order Thinking Ability. *International Education Studies.* Vol. 10, No.6, Hal 114-122.