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DEVELOPING OF ETHNOMATHEMATICS-BASED CURVED-SIDED SPACE-BUILDING MATERIALS TO IMPROVE STUDENTS' MATHEMATICAL PROBLEM SOLVING SKILLS

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ABSTRACT

Incorporating cultural elements into teaching and learning activities is an effort to localize the culture around students by linking the material of the curved side space building with the architecture of the Medan Great Mosque. It is hoped that students will be involved in the learning process and develop a deeper understanding of mathematics. This development research aims to produce valid, practical, and effective ethnomathematics LKPD to improve students' mathematical problem-solving skills in class IX-3 of National Hero Junior High School. The product developed is made of Curved Side Spaces material, which includes tubes, cones, and spheres. This research uses the Research and Development method with the ADDIE model, which includes analysis, planning, development, implementation, and evaluation. The instruments used in data collection include validation sheets, response questionnaires, and problem-solving ability tests. The results showed the results of the LKPD validity test were in the very valid category with an average of 97%, while the results of the practicality of LKPD were in the very practical category of teacher questionnaires with a percentage of 95%, and so the student questionnaires with a percentage of 87%. Post-test results show an increased student's ability to solve mathematical problems, with a result of 0.72 being an effective category. So that the LKPD of Curved Side Room Building Material Based on Ethnomathematics in Medan Great Mosque Architecture to Improve Mathematical Problem-Solving Ability is valid, practical, and effective.

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1. INTRODUCTION

Indonesia is known for its rich culture that covers a wide range of aspects, from architecture, regional clothing, handicrafts to musical instruments, dances, traditional weapons, and even cuisine and language. Education and culture are interrelated and inseparable(Lubis et al., 2018). Incorporating knowledge about this culture into mathematics learning in schools can be done by connecting local cultures from various regions with the subject matter being taught. Preserving local wisdom can be achieved through the incorporation of cultural elements in teaching and learning activities.(Zulfah, 2018). By integrating culture into the learning process, students are able to develop mathematical concepts using elements from their socio-cultural environment. (Nurmeidina & Djamilah, 2022).

The cultural approach to mathematics learning is known as ethnomathematics. D'Ambrosio argues that Ethnomathematics is the study of mathematics practiced by certain cultural groups, including terminology, codes, symbols, myths, and unique ways of thinking and reasoning.(Abi & Gella, 2019). Ethnomathematics is a science that combines culture with mathematics.(Faturrahman & Soro, 2021).. In the context of mathematics learning, culture can be represented by integrating cultural elements related to mathematics into learning activities. The concept of ethnomathematics is used as a learning method or approach that helps students understand mathematical concepts concretely through the prism of culture. The purpose of ethnomathematics-based learning is to form the character of students who appreciate and understand their own culture.

The application of ethnomathematics can be realized through the preparation of teaching materials integrated with cultural and mathematical concepts. To enhance the learning experience, teaching materials are collected from various sources, providing students with a comprehensive collection of information(Magdalena et al., 2020).. Therefore, researchers are interested in developing Learner Worksheets that include elements of ethnomathematics as a valuable teaching resource. LKPD serves as a guide for students, providing theoretical and practical instructions to help them achieve learning objectives. By utilizing LKPD, students are empowered to take ownership of their learning and develop a deeper understanding of the subject matter.(Aprilianti & Astuti, 2020). Therefore, it is important to create educational resources that facilitate ethnomathematics-based approaches.

Based on interviews conducted with one of the mathematics teachers at SMP Pahlawan Nasional, it was found that learning activities still use conventional models which cause many students to depend on the teacher, students tend to be passive when learning takes place so that students cannot build their own understanding and are unable to solve math problems. The media that is often used is usually only in the form of props such as objects around the school, so the development of student worksheets on ethnomathematics-based curved side space building material on the architecture of the Medan Great Mosque is an important initiative in improving students' mathematical problem solving skills. Problem solving ability is the mathematical ability to solve a problem or problem.(Ramadhani, 2018). Mathematical problem solving skills are understanding the problem, planning a solution, solving the problem according to the plan and re-examining the solution procedure.(Siregar & Khayroiyah, 2019)..

The Great Mosque of Medan is not only a religious symbol, but also offers great potential as a source of mathematics learning that is rich in the application of geometry concepts. By linking the material of curved-sided geometry with the richness of local architecture, as seen in the magnificent structure of the Great Mosque of Medan, it is expected that students are engaged in the learning process and develop a deeper

understanding of mathematics. The architectural characteristics of the Great Mosque of Medan have attracted much attention from the people of Medan and its surroundings. Motivated by this, the researcher took the initiative to explore the incorporation of mathematical elements of curved-sided spaces found in the Great Mosque of Medan. This will not only increase students' engagement but also broaden their cultural awareness, especially the architectural heritage, which is located in the surrounding environment, namely the Great Mosque of Medan.

This research aims to develop ethnomathematics-based Learner Worksheets by exploring Medan Great Mosque Architecture, which is applied to curved-sided space building material in class IX, to improve students' mathematical problem solving skills.

2. METHOD

This research uses the research and development method (*Research and Development*). Research and Development is a research method used to produce certain products and test the effectiveness of these products.(Andi Rustandi & Rismayanti, 2021).. In this context, researchers applied the R&D research method with the ADDIE (*Analysis, Design, Development, Implementation, and Evaluation*) development model formulated by Dick & Carey in 1996.

The data analysis conducted in this study used quantitative and qualitative approaches. The qualitative approach involved responses from the validators, which were in the form of criticisms and suggestions for improvement. Meanwhile, the quantitative approach used is descriptive, where data is collected in the form of numbers and analyzed by researchers to obtain specific values. This numerical data was obtained from validation sheets and questionnaires prepared and evaluated by material experts, media and practitioners. Data analysis is carried out to obtain ethnomathematics-based LKPDs that can improve students' problem solving skills, ensuring their validity, practicality, and effectiveness as follows:

a. Validity Analysis

In the process of analyzing validity data, validators are asked to provide validation of each instrument with a Likert scale of 1-4(Munir, 2018). Validation by the validator aims to make the instrument given in accordance with the variable indicators in content, both materially and media.(Fadlilah, 2017)The formula and categorization used to assess validity are as follows:

$$Persentase = \frac{\Sigma\ skor\ per\ item}{skor\ maksimal} x100\%$$

Table 1. Validation Categories

Percentage	Category
76% - 100%	Very Valid
51% - 75%	Valid
25% - 50%	Fairly Valid
≤ 25%	Invalid

b. Practicality Analysis

Determination of the practicality of the ethnomathematics-based LKPD developed was obtained using a response questionnaire sheet containing answers from students and teachers. Calculated using the formula:

$$Persentase = \frac{\Sigma\ skor\ per\ item}{skor\ maksimal} x100\%$$

Table 2. Category of Practicality

Percentage	Category
76% - 100%	Very Practical
51% - 75%	Practical
25% - 50%	Practical enough
≤ 25%	Not Practical

c. Effectiveness Analysis

To determine the effectiveness of the Ethnomathematics-Based LKPD on the Architecture of the Great Mosque, it was tested by averaging the normalized gain calculation of N-Gain, with the formula:

$$N - Gain = \frac{skor\ posttest - skor\ pretest}{skor\ maksimum - skor\ pretest}$$

Table 3. Effectiveness Categories

N-Gain Value	Classification	Description
N- Gain ≥ 0.7	High	Effective
0.3 ≤ N-Gain <0,7	Medium	Effective enough
N-Gain < 0.3	Low	Less effective

3. RESULTS AND DISCUSSION

3.1. Results

The purpose of this research is to produce ethnomathematics-based LKPDs on the architecture of the Medan Great Mosque to improve students' mathematical problem solving skills. The stages of developing ethnomathematics-based LKPD on Medan Great Mosque architecture are as follows:

1. Analysis Stage

The initial stage is the analysis stage. At this stage, several activities are carried out, namely needs analysis activities, curriculum analysis and ethnomathematics analysis as follows:

a. Needs analysis

Needs analysis is carried out to find out the teaching materials used in mathematics subjects. At this stage, an interview was conducted with Mr. Sukamdi S.Pd, a math teacher at National Heroes Junior High School.

b. Curriculum Analysis

Curriculum analysis is carried out to find out the curriculum used at school. The information obtained from the National Hero Junior High School mathematics teacher is using curriculum 13 in mathematics learning.

c. Ethnomathematics Analysis

Ethnomathematics analysis was conducted to find out the culture around students and related to junior high school mathematics class IX. Ethnomathematics analysis was carried out by directly observing and conducting interviews with the management of the Medan Great Mosque to explore the mathematical concepts contained in the architecture of the Medan Great Mosque.

2. *Design* Stage

The second stage in this research is design. By designing LKPD products using word and canva. The stages carried out are as follows:

a. Determining the Title of the Learner Worksheet

The title used in the product is Development of ethnomathematics-based LKPD on Medan Great Mosque architecture to improve students' mathematical problem solving skills.

b. Designing Learner Worksheets

At this stage, the initial design of the LKPD is carried out by designing the product in the form of a ***storyboard***. The design of the product to be developed is seen in terms of design and material. LKPD design consists of components, namely cover, preface, Core Competencies, Basic Competencies, indicators, learning instructions, concept maps, introductory material, and practice questions. The material is arranged based on KI and KD of Curved Side Spaces, namely KD 3.7 and 4.7. The *storyboard* design is then developed into LKPD using Ms. Word and the canva application.

3. *Development* Stage

At this stage, LKPD development and expert validation are carried out. The LKPD development stage is typed in *Microsoft word* first, which consists of components, namely cover, preface, Core Competencies, Basic Competencies, indicators, learning instructions, concept maps, introductory material, and practice questions. If all components have been prepared, the LKPD is combined using the *Canva* application.

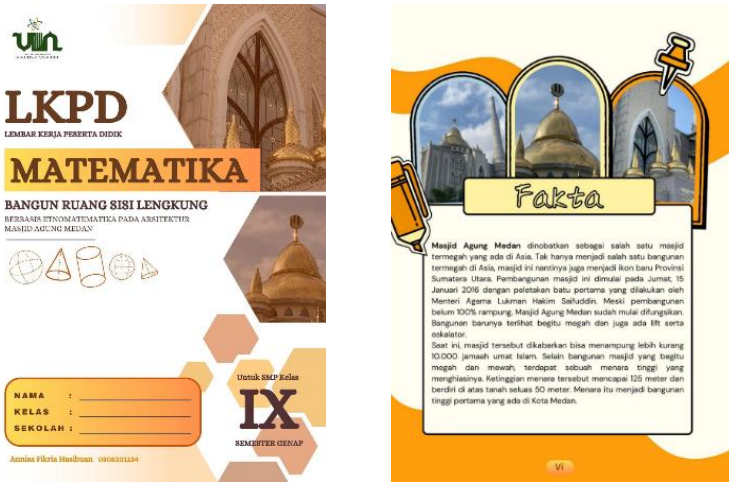
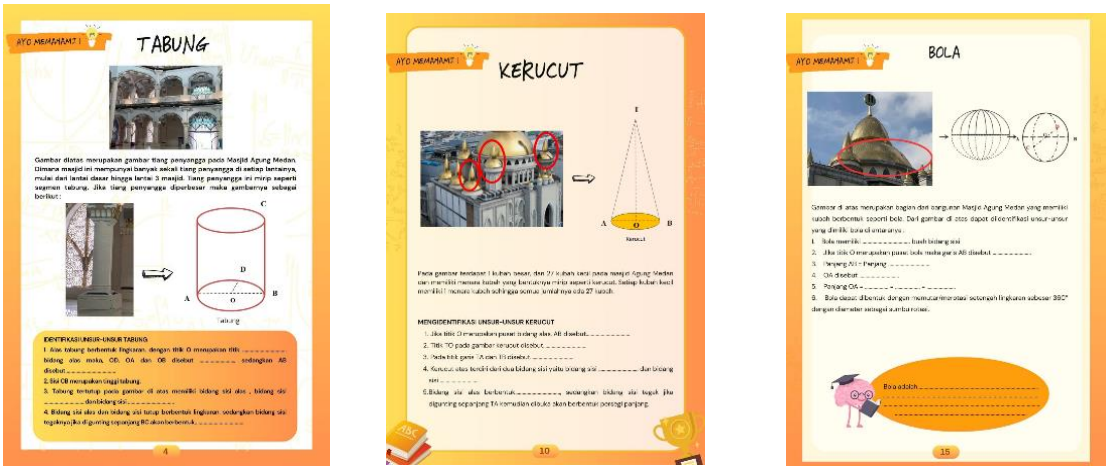


Figure 1. Cover and Facts of Medan Grand Mosque



(a) (b) (c)

Figure 2. Ethnomathematics-based LKPD material

Figure 2 is some of the curved-sided space building LKPD material found in the Medan Great Mosque architecture, where figure (a) is a tube space building contained in the Great Mosque, totaling around 44 poles, figure (b) is a cone space building that surrounds the large dome of the Great Mosque, totaling 27 small domes, and figure (c) is a spherical space building image which is the large dome of the Great Mosque, totaling 1 large dome. Then validation was carried out by experts, namely material experts, media experts, and practitioner experts as a consideration for product revision of Ethnomathematics-Based Learner Worksheets on Medan Great Mosque Architecture. The results of the validation of material experts, media experts, and practitioner experts are as follows:

a. LKPD validation results by material experts

Material expert validators assess the material compiled in the LKPD to be developed. The material expert validator is Mrs. Lisa Dwi Afri, M.Pd. Furthermore, the validator provides assessments, suggestions, and comments related to the media by filling out the validation sheet provided. The aspects of the material expert assessment items are stated in table 4.

Table 4. Material Expert Validation Results

Assessment Aspect	Score obtained	Maximum Score	Percentage	Criteria
Material coverage	15	16	94%	Very valid
Presentation technique	23	24	96%	Very valid
Total	**38**	**40**	**95%**	**Very valid**

b. Media expert validation results

Media expert validators assess the design of the LKPD that has been prepared and will be developed. The media expert validator is Mr. Dwi Ardy Dermawan, M.Pd. Aspects of media expert assessment in Table 5.

Table 5. Media Expert Validation Results

Assessment Aspect	Score obtained	Maximum Score	Percentage	Criteria
Graphics feasibility	19	20	95%	Very valid
Content eligibility	20	20	100%	Very valid
Total	**39**	**40**	**97%**	**Very valid**

c. Practitioner expert validation results

Practitioner expert validators assess the material and design of the LKPD that has been prepared and will be developed. The practitioner expert validator is a mathematics teacher at National Hero Junior High School, Mr. Sukamdi, S.Pd. Aspects of practitioner expert assessment items in Table 6.

Table 6: Practitioner Expert Validation Results

Assessment Aspect	Score obtained	Maximum Score	Percentage	Criteria
Content Aspect	20	20	100%	Very valid
Attractiveness	18	20	90%	Very valid
Total	**38**	**40**	**95%**	**Very valid**

4. *Implementation* Stage

The next stage is the implementation of LKPD, after the validation stage carried out by media experts, materials, and practitioners, the implementation stage is carried out, namely the practicality test. This practicality test was obtained through an educator response questionnaire by a mathematics teacher and a student response questionnaire. The results of the practicality test through the mathematics teacher's response questionnaire were declared "Very Practical" with a percentage of 95%. The aspects of the practicality test assessment through the response questionnaire by the mathematics teacher are stated in Table 7 below:

Table 7. Teacher Response Questionnaire

Number of Teachers	Score obtained	Maximum Score	Percentage	Criteria
1 Teacher	38	40	95%	Very practical

The results of the practicality test through the learner response questionnaire were declared "Very Practical" with a percentage of 87%. The aspects of the practicality test assessment with the learner response questionnaire are stated in Table 8.

Table 8. Learner Response Questionnaire

Number of Students	Score obtained	Maximum Score	Percentage	Criteria
22 students	767	880	87%	Very practical

2. Evaluation Stage

At this stage, the effectiveness test is carried out as seen from the learning outcomes through the pretest and postest assessments given to 22 students of class IX-3 of National Hero Junior High School. Assessment of learning outcomes through *pretests* and *postests* to see the improvement of students' problem solving skills. The results of the data obtained from the *pretest* and *posttest* scores in Table 9.

Table 9. *Pretest* and *Posttest* Results

Test	Test Score			Standard Gain	Category
	Min	Max	Average		
Pretest	25	75	50	0,72	High
Posttest	79	100	86		

3.2 Discussion

In this study, researchers developed a product in the form of ethnomathematics-based LKPD on the architecture of the medan grand mosque to improve students' mathematical problem solving skills as a valid, practical, and effective resource for use in classroom learning. Description of the research results that have been described previously, the first stage is to carry out the *Analysis* Stage, by conducting a needs analysis through interview activities with mathematics teachers, some information is obtained at school so that it becomes the potential for developing LKPD. It was found that learning activities that still use conventional models, the media that are often used are usually only in the form of props such as objects around the school. Furthermore, the *Design* Stage, at this stage the initial design of the LKPD is carried out by designing the product in the form of a storyboard. Product design includes in terms of design and material. LKPD design consists of components, namely cover, preface, Core Competencies, Basic Competencies, indicators, learning instructions, concept maps, introductory material, and practice questions. The material is arranged based on the KD of Curved Side Spaces, namely KD 3.7 and 4.7. The initial design was then developed into LKPD using Ms. Word and Canva application. Furthermore, the *Development* Stage, validation is carried out to test the feasibility of LKPD.

Implementation stage, after validation by media experts, materials, and practitioners, the implementation stage of ethnomathematics-based LKPD on Medan Great Mosque architecture is carried out, at this stage the LKPD that has been developed will then be applied in learning to find out whether the LKPD developed, especially on curved-sided space building material, has an effect on students' mathematical problem solving skills. At this stage, the practicality test was carried out by National Hero Junior High School Class IX-3 students totaling 22 students by distributing ethnomathematics-based LKPD to each student, before working on the LKPD, first discussing the material of curved side space building. After completing the lesson, the researcher gave a questionnaire sheet of 10 questions with 4 aspects to find out the students' response to the Ethnomathematics-Based LKPD on Medan Great Mosque Architecture.

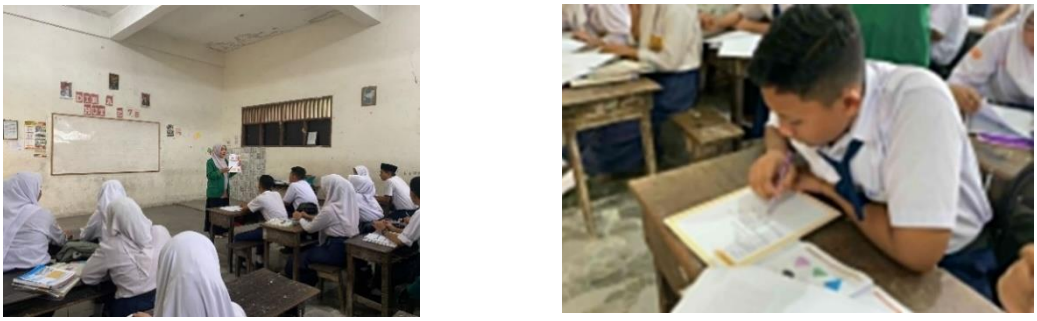


Figure 3. Students working on the Ethnomathematics-based LKPD

The use of Ethnomathematics-based LKPD in the learning process received a positive response from students. During the learning process, the learning situation is classified as more active than usual because students are involved in the learning process. Students said that there was a sense of interest in learning curved-sided space building material that related the architecture of the Medan Great Mosque in it. In line with research conducted by (Maliki et al., 2023) which states that there are some students who are not very interested in mathematics because they think that mathematics is difficult and boring and that is due to the lack of connection between mathematics and students' daily lives, adopting an ethnomathematics approach as a means of increasing students' interest in mathematics.

The advantage of developing this LKPD is that it uses an ethnomathematics-based approach to the architecture of the Medan Great Mosque, where this building is one of the cultural buildings in the students' environment. In line with research conducted by (Ivana et al., 2021) who said that the use of cultural elements to be integrated in learning would be better if done starting from the existing culture in the surrounding environment. And in line with research(Shabira & Andhany, 2023) said that culture-based learning such as ethnomathematics is a strategy for creating a learning environment and planning learning experiences that integrate culture into the learning process. The ethnomathematics-based LKPD on Medan Great Mosque architecture has met the valid and practical and effective requirements. The ethnomathematics-based LKPD on Medan Great Mosque architecture is very valid with an average of 97%. Very Practical based on 95% teacher response questionnaire, and 87.15% student response questionnaire. At the *Evaluation* stage, an effectiveness test is carried out which is seen from learning outcomes through *pretest* and *postest* assessments, effective with an average of 0.72.

5. CONCLUSION

This study found that the LKPD of ethnomathematics-based curved-sided space building material on Medan Great Mosque architecture to improve students' mathematical problem-solving skills met the very valid criteria with an average of 97%. The teacher response questionnaire analysis results showed a percentage of 95% with the criteria "Very Practical," and the analysis of the student response questionnaire showed 87% with the criteria "Very Practical." Moreover, the effectiveness test using the N-Gain Score from the pretest and posttest shows an average of 0.72 with the criteria "High" and "Effective."

REFERENCES

Abi, A. M., & Gella, N. J. M. (2019). Development of Syllabus, RPP and LKS for Geometry Materials Based on Ethnomathematics to Improve Character. *ANARGYA: Scientific*

Journal of Mathematics Education, *2*(1), 1-5. https://doi.org/10.24176/anargya.v2i1.3347

Andi Rustandi, & Rismayanti. (2021). Application of the ADDIE Model in Learning Media Development at SMPN 22 Samarinda City. *Fasilkom Journal*, *11*(2), 57-60. https://doi.org/10.37859/jf.v11i2.2546

Aprilianti, P. P., & Astuti, D. (2020). Development of stem-based lkpd on flat-sided space building material for smp class viii. *JPMI (Journal of Learning ...*, *3*(6), 691-702. https://doi.org/10.22460/jpmi.v3i6.691-702

Fadlilah. (2017). Research Instruments and Their Urgency in Quantitative Research. IAIN Padangsidimpuan.

Faturrahman, M., & Soro, S. (2021). Exploration of Ethnomathematics at Al-Alam Marunda Mosque in Terms of Geometry. *Cendekia Journal: Journal of Mathematics Education*, *5*(2), 1955-1964. https://doi.org/10.31004/cendekia.v5i2.734

Ivana, M., Saryantono, B., & Rahmawati, F. (2021). Development of Ethnomathematics-Based Lkpd with Lampung Tapis Motif to Improve Problem Solving Ability of Grade Vii Students of Smp Negeri 20 Bandar Lampung. *Scientific Journal of Mathematics Education Students*, *3*(2), 1-20.

Lubis, S. I., Mujib, A., & Siregar, H. (2018). Exploration of Ethnomathematics on Gordang Sambilan Musical Instrument. *Edumatika: Journal of Mathematics Education Research*, *1*(2), 1. https://doi.org/10.32939/ejrpm.v1i2.246

Magdalena, I., Sundari, T., Nurkamilah, S., Ayu Amalia, D., & Muhammadiyah Tangerang, U. (2020). Analysis of teaching materials. *Journal of Education and Social Sciences*, *2*(2), 311-326. https://ejournal.stitpn.ac.id/index.php/nusantara

Maliki, M., Fajriah, N., & Hidayanto, T. (2023). Development of Space Building Lkpd Based on Ethnomathematics of Sultan Suriansyah Mosque in Class Viii Junior High School. *Jurmadikta*, *3*(3), 96-103. https://doi.org/10.20527/jurmadikta.v3i3.2141

Munir, N. P. (2018). Development of Trigonometry Textbooks Based on Constructivism with E-Learning Media at IAIN Palopo's Mathematics Tadris Study Program. *Al-Khwarizmi: Journal of Mathematics and Natural Sciences Education*, *6*(2), 167-178. https://doi.org/10.24256/jpmipa.v6i2.454

Nurmeidina, R., & Djamilah, S. (2022). Development of Ethnomathematics-Based Student Worksheets on Quadrilateral and Triangle Materials. In *Hipotenusa Journal of Research Mathematics Education* (Vol. 5, Issue 2).

Ramadhani. (2018). The *Effect of Guided Discovery Learning on Mathematics Problem Solving Ability*. *1*(1), 104-110.

Shabira, N., & Andhany, E. (2023). DEVELOPMENT OF ETHNOMATHEMATICS-BASED LKPD TO IMPROVE STUDENTS' MATHEMATICAL PROBLEM SOLVING SKILLS. *Euclid*, *10*(1), 147-165.

Siregar, T. J., & Khayroiyah, S. (2019). The Effect of Jigsaw Type Cooperative Learning Model on Students' Mathematical Problem Solving Ability. *Journal of MathEducation Nusantara*, *2*(2), 150-154. http://jurnal.pascaumnaw.ac.id/index.php/JMN/article/view/85/75

Zulfah, Z. (2018). Needs Analysis of Local Wisdom-Based Problem Development. *Cendekia Journal: Journal of Mathematics Education*, *2*(1), 1-6. https://doi.org/10.31004/cendekia.v2i1.27