Realistic Mathematics Education (RME) Model on Conversion and Addition of Units of Weight with the Topic of Sidoarjo Milkfish Auction in Elementary School

Kartika Budi Amanda[1*]; Ika Rahmawati[2]; Wiryanto[3]

[1,2,3]*Primary School Teacher Education, Universitas Negeri Surabaya, Indonesia*
[1*]*Corresponding Email: kartika.21100@mhs.unesa.ac.id, Phone Number: 0895 xxxx xxxx*

Article History:
Received: Jun 05, 2024
Revised: Jul 15, 2024
Accepted: Dec 24, 2024
Online First: Jan 07, 2025

Keywords:
Conversion,
Milkfish Counting,
Operations Auction,
Realistic Mathematics,
Weight Units.

Kata Kunci:
Konversi,
Lelang Bandeng,
Matematika Realistik,
Operasi Hitung,
Satuan Berat.

How to cite:
Amanda, K. B., Rahmawati, I., & Wiryanto, W. (2025). Realistic Mathematics Education (RME) Model on Conversion and Addition of Units of Weight with the Topic of Sidoarjo Milkfish Auction in Elementary School. *Edunesia : Jurnal Ilmiah Pendidikan*, *6*(1), 139-.

Abstract: Mathematics learning using the correct Model and approach is important. This is due to the lack of in-depth understanding of mathematical concepts. This qualitative descriptive study uses the Gravemeijer & Cobb Design Research Method. The study was designed to prove the truth of the assumptions that have been written in the learning trajectory or HLT (Hypothetical Learning Trajectory) and its influence on students' conceptual understanding using the RME (Realistic Mathematics Education) approach on the material of weight unit conversion and addition arithmetic operations using Students' worksheet with the topic of the Sidoarjo milkfish auction which is a guideline for student activities. This study was conducted with research subjects of grade IV students of Ma'rif NU Kyai Rodliyah Elementary School. The research subjects were two groups in the class, each with two students. The stages of the research carried out were research preparation, implementation of experimental design, and retrospective analysis. Based on this study, it can be seen that the stages of learning activities with the RME model consist of stages of real-world situations (situations), models that describe problem situations (Model of), models for solving problems (Model for), and stages of formal mathematics with Students' worksheet media that raises the topic of the Sidoarjo milkfish auction can make it easier for students to understand the concept of material regarding the conversion of weight units and their addition arithmetic operations.

Abstrak: Pembelajaran matematika dengan menggunakan model dan pendekatan yang tepat penting dilakukan. Hal ini dikarenakan kurangnya pemahaman konsep matematika secara mendalam. Penelitian ini merupakan penelitian deskriptif kualitatif dengan metode penelitian desain (Design Research Method) milik Gravemeijer & Cobb. Penelitian dirancang untuk membuktikan kebenaran dugaan yang telah tertulis dalam lintasan pembelajaran atau HLT (*Hypothetical Learning Trajectory*) serta pengaruhnya terhadap pemahaman konsep peserta didik menggunakan pendekatan RME pada materi konversi satuan berat dan operasi hitung penjumlahan menggunakan LKPD dengan topik lelang bandeng Sidoarjo yang menjadi pedoman aktivitas peserta didik. Penelitian ini dilakukan dengan subjek penelitian peserta didik kelas IV SD Ma'rif NU Kyai Rodliyah. Subjek penelitian yaitu dua kelompok di dalam kelas yang masing-masing kelompoknya berjumlah 2 peserta didik. Tahapan penelitian yang dilakukan yaitu persiapan penelitian, pelaksanaan desain eksperimen, dan analisis retrospektif. Berdasarkan penelitian ini dapat diketahui bahwasanya tahapan aktivitas pembelajaran dengan model RME terdiri dari tahapan situasi dunia nyata (situations), model yang menggambarkan situasi permasalahan (*model of*), model untuk menyelesaikan masalah (*model for*) serta tahapan matematika formal dengan media LKPD yang mengangkat topik lelang bandeng Sidoarjo dapat mempermudah peserta didik dalam memahami konsep materi mengenai konversi satuan berat dan operasi hitung penjumlahannya.

https://doi.org/10.51276/edu.v6i1.966

A. Introduction

Based on the PISA 2022 survey released by the OECD, the math skills of Indonesian students decreased on average with a score of 366 points, far below the average OECD country, which ranges from 465 to 475 points (OECD, 2022). This decline illustrates a serious problem in learning mathematics in Indonesia. One of the problems Indonesian students face in learning mathematics is the lack of proper concept understanding (Prasasti et al., 2020). Concept understanding is one of the important factors in learning mathematics and is closely related to students' interest in learning (Höft & Bernholt, 2019). If students already understand mathematical concepts correctly, these students will quickly solve the problems in learning (Radiusman, 2020). This aligns with Jacques' statement (Radiusman, 2020), which reveals that mathematics is a hierarchical subject where knowledge of a topic continues the previous topic. Based on the previous statement, it can be concluded that a learner cannot construct new mathematical knowledge if they do not first master the basic concepts related to the new knowledge.

Understanding the right mathematical concepts is important to be taught since elementary school. This is because children have a solid foundation as a provision for the next stage (Hayati & Asmara, 2021). For elementary school students, understanding mathematical concepts tends to be difficult because mathematical concepts are abstract (Murdiana et al., 2022). Therefore, learning needs to be connected to everyday problems, close to students and r, and relevant to society (Primasari et al., 2021). This is to concretize abstract things to make it easier for students to learn mathematics. This statement is also in line with Piaget's cognitive development theory, which states that elementary school students are in the concrete operational stage, where they begin to be able to think logically about real objects and events (Ibda, 2015). Students' concept understanding is expected to improve by choosing learning models and approaches by their cognitive development stage.

The RME Learning Model aligns with this principle. This is because RME helps learners to think from the abstract to the concrete (Afriansyah, 2016). In RME, learners are invited to understand math concepts through relevant everyday situations, such as counting money or measuring length. This helps children connect math to the real world and strengthens their understanding of abstract concepts. Using real situations, RME supports learners' cognitive development according to their concrete operational stage, making math learning more meaningful and effective. RME also provides opportunities for learners to rediscover and reconstruct mathematical concepts based on realistic problems given by the teacher. This makes learners not easily forget the basic concepts learned because learners build their knowledge (Chisara et al., 2019)

In the process, RME provides a gradual learning process starting from abstract concepts to fundamental concepts. This series will formulate the trajectory that must appear in learning (learning trajectory). Therefore, teachers must be able to formulate pedagogical didactical anticipation through a Hypothetical learning trajectory commonly abbreviated as HLT (Primasari et al., 2021). HLT contains the design of learning steps that estimate how

https://doi.org/10.51276/edu.v6i1.966

students' understanding will develop through certain activities based on the expected learning objectives (Fuadiah, 2017). This learning trajectory is helpful for teachers to determine and also formulate learning objectives to be achieved, then teachers can decide what strategic steps will be used to realize these objectives. *An iceberg model can describe the learning trajectory* (Rokhmawati et al., 2023). This iceberg will illustrate the various ways of representing mathematics and used to support mathematics learning about mathematical goals (Marella & Fiangga, 2024).

In its application, RME learning is very suitable when implemented with an ethnomathematics-based approach. Ethnomathematics is an integration between mathematics and culture. This term was introduced by a Brazilian mathematician named D'Ambrosio in 1977 (Andriyani & Kuntarto, 2017). The ethnomathematics approach makes mathematics more readily accepted by students because it is more realistic (Surat, 2018.). In addition, the cultural elements integrated into mathematics help ease students to examine mathematics so that it has an impact on improving the quality of student learning outcomes and helping to recognize, love, and preserve local culture (Nisa et al., 2023).

The researcher in this study raised the topic of the Sidoarjo milkfish auction as a typical East Javanese culture integrated into mathematics. The milkfish auction is a local Sidoarjo community activity held annually to commemorate the Prophet Muhammad's birthday to increase economic growth and community religiosity (Masyitoh, 2017). In this context, learners can learn math using the milkfish auction activity, which is part of the local tradition. They can perform conversions as well as unit weight operations. This approach allows learners to see how math is used in their culture, making learning more relevant and meaningful. By connecting mathematics with local culture, RME and ethnomathematics strengthen students' understanding through real contexts and hands-on experiences. Thus, learners will get two experiences simultaneously (Nurazizah, 2023).

Based on the problems at Ma'rif NU Kyai Rodliyah Elementary School, especially students' difficulty understanding the weight unit conversion concept, this research needs to be done. The main problem experienced by students lies in the error of dividing or multiplying the weight unit ladder. Learners also still have difficulty interpreting story problems related to the calculation operation of weight units.

Previous research by Fatmawati & Hanik (2024) entitled "Sidoarjo Culture-Based Mathematical Literacy in Ethnomathematics Perspective" showed mathematical principles related to batik sari kenongo, candi pari and also the activities of cemandi farmers. The study did not describe the mathematical principles of the Sidoarjo milkfish auction and the application of ethnomathematics-based learning in the classroom. Therefore, the researcher's study related to the integration of Sidoarjo milkfish auction culture in mathematics is unique because no research has raised the topic of Sidoarjo milkfish auction for the application of the RME model with HLT in learning weight unit conversion. This discovery is significant so that learning mathematics becomes more enjoyable and easy to understand and introduces the surrounding culture to students.

https://doi.org/10.51276/edu.v6i1.966

Based on several statements above, the purpose of this study is to prove the validity of the assumptions contained in the HLT and its effect on students' concept understanding by applying the RME Model to the material of weight unit conversion and weight unit addition using the Students' worksheet which raises the topic of the Sidoarjo milkfish auction as a guide to student activity.

B. Method

This descriptive qualitative study uses Gravemeijer & Cobb's design research method. According to Gravemeijer & Cobb (Primasari et al., 2021), the stages of design research consist of (1) research preparation (preparing for the experiment), (2) implementation of experimental design (experimenting in the classroom), (3) retrospective analysis (conducting retrospective analysis). This research was conducted on fourth-grade students at Ma'rif NU Kyai Rodliyah Elementary School. There were 17 learners enrolled. Meanwhile, three class groups became the research subjects, with six learners as subjects.

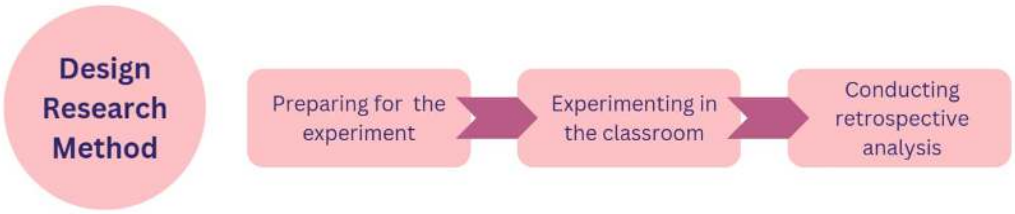

Figure 1. Research Flow

In the first stage, the researcher made preparations with the data sources collected through teacher interviews and classroom observations to find out information about students' understanding and mastery of the material of weight unit conversion and its calculation operations. The data was used to analyze the HLT on weight unit conversion and arithmetic operations. The analysis results are outlined in the HLT table, which contains the activity design, cognitive level, and the alleged learning process.

Table 1. Hypothetical Learning Trajectory

No	Activities	Level	Alleged Learning Process
1	Learners calculate the total weight of the three winners of the milkfish auction.	Situations	Learners immediately calculate the total of the three milkfish regardless of the unit of weight.
2	Learners draw the milkfish belonging to the three auction winners on the winner's ladder and write the weight.	Model of	Learners draw and write the weight of the three milkfish auction winners on the winner's ladder and do not realize the difference in the unit weight of one of the milkfish.
3	Learners are given a stimulus question: "Try		Learners try to reconfirm and realize that the unit weight of

https://doi.org/10.51276/edu.v6i1.966

No	Activities	Level	Alleged Learning Process
	reading the problem again, you are asked to add up in kg units, right? Are all the milkfish units the same?"		Pak Edi's milkfish should be converted to kg.
4	Learners gradually convert Mr. Edi's milkfish's unit weight with the unit ladder from g to dag, dag to hg to hg to kg.	Model for	Learners convert the unit weight of Mr. Edi's milkfish by filling in the blank dots on the Students' worksheet according to the instructions until they finally find the correct unit result.
5	Learners are given a quick way to convert units of weight without the need to count the ladders one by one and are directed to check if the results are the same as the previous method.		Learners fill in the dots in a quick way and find the same result as the first way (counting the stairs one by one).
6	Learners add up the weight of the three milkfish winners that have equalized their weight units.		Learners fill in the dots in the "Let's Add" activity on the Students' worksheet and find the correct addition result.
7	Learners solve the problem given, namely determining the sum of the weight of the three milkfish winners with the final result in kg.	Formal	Learners solve the problem by converting weight units to other standard units and addition operations.

The table is used as the primary reference in developing learning tools that will be tested. In the second stage, researchers tested the design made in the classroom. At this stage, the Students' worksheet was used to pour from the iceberg design based on HLT and then implemented by students in the learning process.

https://doi.org/10.51276/edu.v6i1.966

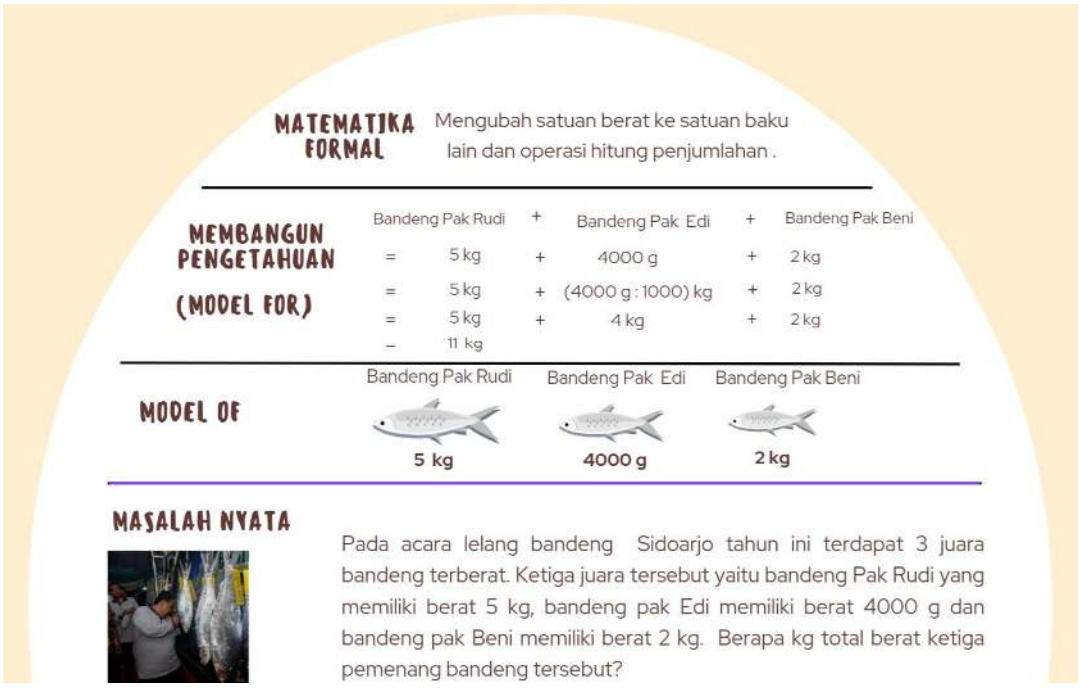

Figure 2. Iceberg Design

The last stage is retrospective analysis. The researcher evaluates the success of the learning activities that have been carried out. The results of these observations will be analyzed and compared with the HLT that has been designed. This aims to determine the success or failure of the objectives of each stage that students have passed.

C. Result and Discussion

Result

The researcher designed four activities. Before the activity started, the researcher divided the learners into eight groups, each consisting of 2-3 children. The four activities are Situations, Model of, Model For, and Formal. Furthermore, the explanation of the activity results is as follows:

Activity 1

In the first activity, students are invited to read the text about the Kawak milkfish auction on the Students' worksheet. This is to introduce the milkfish auction as the main topic of the ethnomathematics approach in the RME model in learning activities. Furthermore, learners will be directed to read stories containing ethnomathematics-based problems with the topic of the Sidoarjo milkfish auction regarding the conversion of units of weight and the addition calculation operation. At this stage, learners are at the situation level.

https://doi.org/10.51276/edu.v6i1.966

Learners are expected to understand the problems in the story and realize that the weight units added together must be the same for each element in the weight addition operation. The following is an excerpt of the conversation between researchers and learners:

Researcher: "What do you think is asked in the story problem?"
A : "The total weight of the three winners of the milkfish auction, ma'am."
Researcher: "If what is asked is total, what should you do?"
A : "Add up mom."

From the conversation transcript, learners already understand the concept of addition.

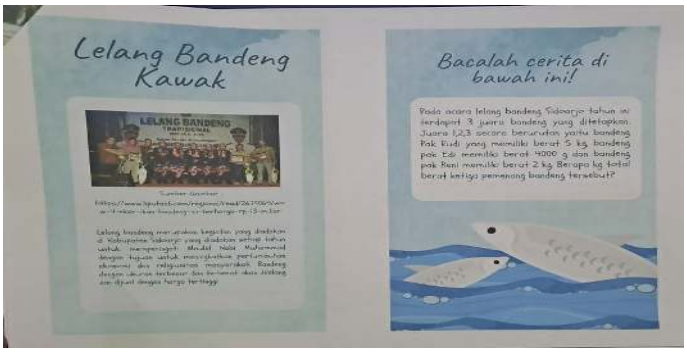

Figure 3. Introductory Text and Problem Story with the Topic of Kawak Milkfish Auction

Figure 4. Learners Answer Questions Related to Situation Questions Asked by the Researcher

Activity 2

In activity 2, learners will do modeling from a problem story with the topic of a kawak milkfish auction. This modeling is in the form of drawing fish on a scale that reads the weight of each fish and its unit of weight. At this stage, learners enter the Model Of level. With this, learners are expected to find the difference in weight units between milkfish that will be added up and understand the need to convert weight units first to add up each

https://doi.org/10.51276/edu.v6i1.966

milkfish to produce the same weight unit as the weight unit asked in the problem. The following is an excerpt of the conversation between researchers and learners:

Researcher: "Are the milkfish that you drew all the same size?"
F : "Different mom."
Researcher : "Why is it different?"
D : "Because the first winner is heavier than the second winner, then the second winner is heavier than the third winner. If it's heavier, then the picture of the fish will be bigger mom."
Researcher: "Wow, yes, very smart. Now try to read the story again, there you are asked to add up in kg units, right? Are all the milkfish units the same?"
F : "Not yet mom, there is a unit 'g'."
Researcher: "Then what should I do?"
D : "Change it ma'am, the grams must be converted to kilograms. Then, just add it up."
Researcher: "Yes, that's called converting."

From the transcript, it can be seen that students already understand the story modeling of the problem raised. In addition, learners also understand the need for similarity of weight units in addition to calculation operations with the encouragement of triggering questions from the researcher.

Figure 5. Learners Draw Milkfish in the Students' worksheet Activity

Figure 6. Model of Activity

https://doi.org/10.51276/edu.v6i1.966

Activity 3

In activity 3, learners use a unit ladder to convert gram (g) to kilogram (kg) weight units. Previously, learners were given an understanding that if the weight unit goes up, one ladder will be divided by ten and vice versa; if the weight unit goes down, one ladder will be multiplied by ten. Conversion of weight units using this unit ladder is done step by step starting from grams to dag, dag to hg, then the last hg to kg. This is done so that students understand the concept of unit conversion correctly. Then, learners are also given a quick way to directly divide the gram (g) weight unit by one thousand if they want to convert it to kilogram (kg). Learners are expected to compare and conclude whether the results between the step-by-step and quick methods will be the same. The following is an excerpt of a conversation between researchers and learners:

Researcher: "How, are the results of the step-by-step method the same as the the quick way?"
R : "Same mom."
Researcher: "Which method do you prefer?"
R : "The quick way, Mom, so it does not take long to calculate.

From the transcript, students already understand the origin of lightning, so there are no misconceptions in students' understanding of the conversion of weight units.

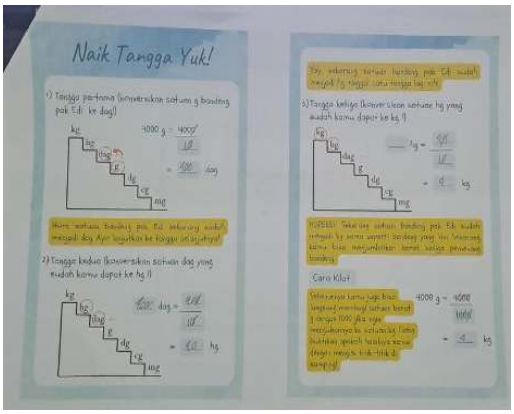

Figure 7. Model For Activity

Figure 8. The Researcher (Teacher) Guides Students

https://doi.org/10.51276/edu.v6i1.966

Activity 4

In activity 4, learners have finished doing the unit weight conversion activity, so they can continue the calculation operation that has not been completed and get the total milkfish from the three winners. The data in the Students' worksheet shows that all groups found the correct answer.

Figure 9. Formal Math Outcomes

Discussion

Based on the activity results, it can be seen that the stages of learning activities carried out by students are by the HLT that has been made. Learners can follow the learning well according to the Students' worksheet instructions. The stages make students easily understand the abstract concepts of conversion and unit weight calculation operations. This can be measured from the observations of researchers in the classroom, before the implementation of RME-based learning, students still make mistakes in dividing or multiplying when working on unit weight conversion problems. However, when RME-based learning is implemented, students become aware of the basic concepts of converting weight units. The work does not use instant formulas but gradually constructs students' understanding. This can be seen in activity 3, where students compare the results of the quick way and gradual results, according to the Students' worksheet produce the same number. This is in accordance with the results of research conducted by (Nurhayanti et al., 2022), which states that applying the realistic mathematic education model can improve concept understanding and student learning outcomes. The increase can also be seen in students' activeness in learning activities.

https://doi.org/10.51276/edu.v6i1.966

D. Conclusion

Based on the research that has been done, the RME model with the topic of the Sidoarjo milkfish auction can help students understand the concept of conversion and the operation of calculating the addition of weight units in depth. Learning stages start from situational activities such as identifying problem stories and pictures, then continue with the Model of the stage through drawing activities. The Model for the stage is through the activity of climbing the ladder of unit weight and ending with the formal mathematics stage by concluding all the stages passed. This helps provide authentic examples for students in solving conversion problems and unit weight addition calculation operations.

The RME Learning Model, which is carried out in the correct order, and the Learner Worksheet, which is well organized according to step by-step and begins with situational activities, help students understand abstract concepts to be more concrete. In addition, fun learning activities also encourage students' enthusiasm in participating in learning.

Future research is expected to raise material on conversion and arithmetic operations of weight units that are more complex and diverse from the topic of this Sidoarjo milkfish auction. In addition, other materials, such as the comparison of length and weight of milkfish, can also be further explored and developed.

References

Afriansyah, E. A. (2016). Investigasi Kemampuan Problem Solving dan Problem Posing Matematis Mahasiswa via Pendekatan Realistic. *Mosharafa: Jurnal Pendidikan Matematika*, *5*(3), 269-280. https://doi.org/10.31980/mosharafa.v5i3.416.

Andriyani, K., & Kuntarto, E. (2017). Etnomatematika: Model Baru dalam Pembelajaran. *Jurnal Gantang*, *2*(2), 133-144.

Chisara, C., Hakim, D. L., & Kartika, H. (2019). Implementasi pendekatan Realistic Mathematics Education (RME) dalam pembelajaran matematika. *Prosiding Sesiomadika*, *1*(1b).

Fatmawati, I., & Hanik, U. (2024). Penerapan Modul Ajar Matematika Berbasis Etnomatematika Kearifan Lokal Tradisi Nyadran Sidoarjo. *Jurnal Basicedu*, *8*(1), 806-814. https://doi.org/10.31004/basicedu.v8i1.7189.

Fuadiah, N. F. (2017). Hypothetical Learning Trajectory pada Pembelajaran Bilangan Negatif Berdasarkan Teori Situasi Didaktis di Sekolah Menengah. *Mosharafa: Jurnal Pendidikan Matematika*, *6*(1), 13-24. https://doi.org/10.31980/mosharafa.v6i1.425.

Hayati, R., & Asmara, D. N. (2021). Analisis Pemahaman Konsep Matematis Mahasiswa PGSD pada Mata Kuliah Konsep Dasar Matematika. *Jurnal Basicedu, 5*(5), 3027–3033. https://doi.org/10.31004/basicedu.v5i5.976.

Höft, L., & Bernholt, S. (2019). Longitudinal Couplings Between Interest and Conceptual Understanding in Secondary School Chemistry: An Activity-Based Perspective.

https://doi.org/10.51276/edu.v6i1.966

International Journal of Science Education, 41(5), 607–627. https://doi.org/10.1080/09500693.2019.1571650.

Ibda, F. (2015). Perkembangan Kognitif: Teori Jean Piaget. *Intelektualita*, *3*(1).

Marella, S. D., & Fiangga, S. (2024). Pengembangan HLT Menggunakan Pendekatan PMRI Pada Materi Barisan dan Deret Aritmetika Menggunakan Konteks Rumah Limasan. In *Prosiding Seminar Nasional Penelitian Dan Pengabdian Kepada Masyarakat (SNPP)*, 3, 198-210.

Masyitoh, K. U. N. I. (2017). Lelang Bandeng Tradisional di Kabupaten Sidoarjo Tahun 1969-2006. *AVATARA, e-Journal Pendidikan Sejarah*, *5*(2), 260-272.

Murdiana, I. N., & Hasbi, M. (2022). Pelatihan Penggunaan Media Kongkret dalam Penanaman Konsep pada Operasi Hitung Bilangan Bulat. *Jurnal Kreatif Online*, *10*(1), 13-26. https://doi.org/10.22487/jko.v10i1.1915.

Nisa, H., Choirudin, C., Anwar, M. S., & Wardana, M. R. F. (2023). Implementasi Etnomatemtika Berbasis Alat Kesenian Rebana dalam Pembelajaran Bangun Ruang. *Delta-Phi: Jurnal Pendidikan Matematika*, *1*(3), 205-210. https://doi.org/10.61650/dpjpm.v1i3.195.

Nurazizah, K. (2023). Etnomatematika: Meningkatkan Minat dan Pemahaman Matematika melalui Media Permainan Congklak. *Jurnal Ilmiah Pendidikan Matematika Al Qalasadi, 7*(2), 138–147. https://doi.org/10.32505/qalasadi.v7i2.6793.

Nurhayanti, H., Hendar, H., & Kusmawati, R. (2022). Model Realistic Mathematic Education dalam Meningkatkan Pemahaman Konsep Matematika pada Materi Pecahan. *Jurnal Tahsinia*, *3*(2), 156-166. https://doi.org/10.57171/jt.v3i2.334.

OECD. (2022). *Hasil PISA 2022*. Retrieved from https://www.oecd.org/publication/pisa-2022-results/country-notes/indonesia-c2e1ae0e/.

Prasasti, D., Awalina, F. M., & Hasana, U. U. (2020). Permasalahan Pemahaman Konsep Siswa pada Pelajaran Matematika Kelas 3 Semester 1. *MANAZHIM*, *2*(1), 45-53. https://doi.org/10.36088/manazhim.v2i1.659.

Primasari, I. F. N. D., Zulela, Z., & Fahrurrozi, F. (2021). Model Mathematics Realistic Education (RME) pada Materi Pecahan di Sekolah Dasar. *Jurnal Basicedu, 5*(4), 1888–1899. https://doi.org/10.31004/basicedu.v5i4.1115.

Radiusman, R. (2020). Studi Literasi: Pemahaman Konsep Anak pada Pembelajaran Matematika. *FIBONACCI: Jurnal Pendidikan Matematika Dan Matematika, 6*(1), 1-8. https://doi.org/10.24853/fbc.6.1.1-8.

Rokhmawati, L. N., Ratnaningsih, N., & Ni'mah, K. (2023). Aturan Penjumlahan dan Perkalian dalam Kaidah Pencacahan: Bagaimanakah Desain Hypothetical Learning Trajectory Berbasis RME?. *JPMI (Jurnal Pembelajaran Matematika Inovatif)*, *6*(3), 937-950. https://doi.org/10.22460/jpmi.v6i3.17321.

https://doi.org/10.51276/edu.v6i1.966

Surat, I. M. (2018). Peranan Model Pembelajaran Berbasis Etnomatematika sebagai Inovasi Pembelajaran dalam Meningkatkan Literasi Matematika. *Emasains: Jurnal Edukasi Matematika Dan Sains*, *7*(2), 143-154. https://doi.org/10.5281/zenodo.2548083.