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Developing Students' Worksheet of Cuboid and Cube Volume with Realistic Mathematics Education (RME)

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ABSTRACT

The aim of this study is to develop a Student Worksheet for students of 8th grade SMP of cube and cuboid volume material based on Realistic Mathematics Education (RME) which have valid and practical criteria. It was development research, adapted from the 4D development model. Validation was carried out by material, media, and learning experts. The Student Worksheet developed was tested in a small group test with the subjects of 6 students. The results showed the RME-based Student Worksheet is valid by evidence that an average total score of 3.24 was obtained with a percentage of 80.92%. The assessment by the students was performed in a small group test to test the practicality. From a small group test, an average total score of 3.44 was obtained with a percentage of 86%. Therefore, this RME-based Student Worksheet is valid and practical.

Keywords**:** *realistic mathematics education, student worksheet, 4d model*

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INTRODUCTION

One of the sub-subjects in geometry that student's study is called "Building Space," and it is separated into two categories, a flat solid figure side and a curve solid figure side. Students should be able to construct the three-dimensional shapes cube and cuboid because they are so common in daily life. According to certain research findings, the students have a poor grasp of geometry (Suryani, et al., 2020) and they need to develop new mental habits in order to learn better (Kurniawan, et al., 2019). It requires a learning process through progressive and sequential habituation and is based on prior learning experiences in order to understand a mathematical notion or idea that is organised hierarchically. If students grasp geometric concepts progressively, they can build structured mathematical knowledge and represent it based on their understanding level.

Progressive mathematization through the application of mathematical models is one of the characteristics of Realistic Mathematics Education (RME). Situational and mathematical models created by students themselves are referred to as models. This implies that the students create models for problem-solving. The model initially represents a scenario that the students

are familiar with. The model finally becomes a standalone entity through a process of generalization and formalization. That is employed as a model for mathematical reasoning is now possible (Jeannotte & Kieran, 2017; Shodikin, et al., 2021). Because to the Realistic Mathematics Education (RME) strategy, students are no longer reluctant to express their opinions, dare to offer alternate issue solving with their fellow learners, and improve in their inventiveness when working together to solve a problem, which considers the local conditions (culture, environment, or context) (Agustina, Widadah, & Nisa, 2021; Laurens; et al., 2018; Rawani, et al., 2023).

Because of this advantage, every math teacher in Indonesia must be aware of how easily RME may be included into the educational process. RME has been implemented as a teaching strategy in Indonesia. It corresponds to RME principles and characteristics. According to the curriculum's goals, RME is widely acknowledged as one of the greatest methods to teach mathematics since it focuses on teaching students high order thinking skills including building their own knowledge, problem-solving, and critical and creative thinking (Palupi & Khabibah, 2018). There are three RME principles, namely: 1) rediscover, 2) didactic phenomena, and 3) self-developed models. Based on these three principles, the RME approach has five characteristics: 1) real-world use, 2) modelling, 3) use of production and construction, 4) use of interaction and 5) intertwining (Van den Heuvel-Panhuizen & Drijvers, 2020).

The teacher must try to improve upon the concepts of the subject that the students have already learned. Based on the data gathered in the field, a learning tool that can assist students in enhancing their comprehension of theoretical concepts is required, such as a Students' Worksheet. Students Worksheet serves as a guide for teachers and students working together to learn and gives students the chance to participate actively while also assisting them in developing and discovering concepts through thinking process skills. In experiments, demonstrations, and conversations, Students Worksheet can serve as a roadmap or a series of steps. Students Worksheet is typically a translation or development that originates in student textbooks (Hidayati & Fauziah, 2019).

Pratama, Izzati, & Alpindo (2022) did research to create interactive learning materials for junior high school that reflect the intricacies of Malaysian culture and RME traits. The created item has met reliable and useful standards. This study suggests that it is possible to examine the efficacy of interactive learning materials that incorporate Malay culture and RME elements. Additionally, study was undertaken Oktavani, Fitri, & Jufri (2023) on the developing of worksheets based on RME on flat-sided geometric material. The findings show that the student worksheet is valid, practical, and efficient. However, both investigations needed to be developed further, which is why this study was carried out. For the purpose of teaching eighth-grade students how to construct the volume of a cuboid and a cube, an RME-based student's worksheet will be constructed in the course of this research.

METHODS

Type of Research

This study employs producing a specific product and evaluating its feasibility through research and development, also known as R & D. The study employs Thiagarajan's (in Indaryanti et al., 2019) development model, commonly referred to as 4D. The 4D development model has four research steps; 1) define, 2) design, 3) development, and 4) dissemination.

Procedure

Schematically, the development of realistic mathematics education-based worksheet in the volume of cube and cuboid matter in Figure 1.

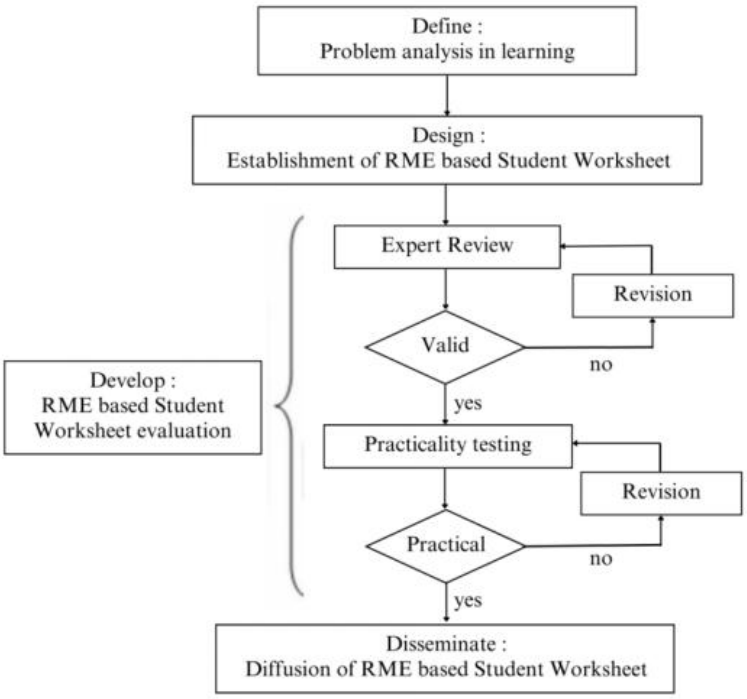


Figure 1. 4D model Stages of Development

The 4D development model is employed in this research. These were the development plans:

a. Define

Following were the procedures to be followed during the analyse phase:

- *Curriculum Analysis*

This phase is helpful to understand the syllabus and the curriculum used in schools, the skills to be attained, as well as the current mathematics materials which can serve as source supplies for creating students' worksheets based on Realistic Mathematics Education (RME).

- *Characteristics Analysis*

With the goal of identifying the learner's initial aptitude, experience, likes, and learning motivation, an analysis of their features was conducted. The researcher conducted interviews with educators and students to understand more about this issue.

- *Material Analysis*

By considering principles and characteristics of realistic mathematics teaching, material analysis is done with the intention of examining the content to be utilized in student worksheets and analyzing activities and problems that are suitable for students.

- *Formulate Objectives*

The objectives were designed to address the problems currently plaguing the educational system. This was achieved by offering the suitable remedy for the inconsistency and desired expectations.

b. Design

All necessary items would be created at this stage in accordance to the define phase. After define phase, the researcher finds the right solution to solve the issue by producing a product that will be applied to learning activities. The researcher would create worksheets for students based on Realistic Mathematics Education (RME), which would be used as instructional material during the learning process.

c. Develop

The following step was to develop the product after the design phase's procedures had been followed. Making the Realistic Mathematics Education (RME)-Based Student Worksheet and validating it with three experts, a material expert, a media expert, and a learning expert, were the tasks to be completed in this phase. Small group test were also carried out in this phase.

d. Dissemination

The dissemination stage is the final step in the creation of 4D model learning tools. The dissemination phase is used to market the created product and ensure consumer acceptance. Selective packaging materials are required to create the real form.

Instrument and Data Collection

This development research used both quantitative and qualitative data. Quantitative data came from worksheet validation and small group testing. A team of experts in content, media, and learning evaluated the worksheets using questionnaires. Student responses from the small group test were also collected through questionnaires to assess practicality. Qualitative data were gathered from feedback and suggestions during the validation and testing process.

Data Analysis

The questionnaire was provided as a scoring system that was quantitatively analyzed. Table 1 by (Imsa-ard, 2020) provides score data on the student worksheet's validity and practicality.

Table 1. Score Data

Criteria	Score
Very good	4
Good	3
Low	2
Very Low	1

The results of the validation by material, media, and learning experts, as well as the results of the practical from the student's answer, will be processed from the scale 1-4 assessment using the formula used to measure score for each aspect. Analysis of the computation, per Sudjana (2005: 67), is as follows:

$$\bar{x} = \frac{\sum x_i}{n}$$

Description:

$\bar{x}$ = Mean

x_i = Total validation score of all respondents

n = Total questions

Category Value in Table 2 is the criteria that was used to group the calculations.

Table 2. Category Value

Interval Value	Category	
	Validation	Practical
$3.25 < x \leq 4$	Very Valid	Very Practical
$2.5 < x \leq 3.25$	Valid	Practical
$1.75 < x \leq 2.5$	Invalid	Inpractical
$1 < x \leq 1.75$	Very Invalid	Very Inpractical

RESULTS AND DISCUSSION

Research Result

The outcomes among the developmental studies: (1) a Student Worksheet on a Realistic Mathematics Education (RME)-Based Volume of Cube and Cuboid in Class VIII SMP (2) Evaluation of the worksheet by material, media, and learning experts. (3) The responses on the developed math student worksheet. The 4D development process, which comprises four phases: define, design, develop, and disseminate, was utilized to create the math student worksheet. However, this study just covers the development phase.

a. Define

The define phase was the initial step in the creation of the worksheet. The researcher carried out several tasks during this phase, including curriculum analysis, characteristic analysis, material analysis, and objective formulation. Following are tasks to complete during the define phase:

- *Curriculum Analysis*

In this phase, it was found that the curriculum used was a Kurikulum Merdeka that focused on students' thinking processes in learning a material. The principles and characteristics of RME are in accordance with the objectives of holding a Kurikulum Merdeka.

- *Characteristics Analysis*

This phase has revealed that there are still a significant number of eighth-grade students who dislike math. This is brought on by initial misconceptions that math is a tough subject to understand since they don't love it.

- *Material Analysis*

During this phase, it was discovered that one of the resources that could be developed was the volume of cubes and blocks, a topic that can be taught using a practical approach to mathematics education and is one that can be found in everyday life.

- *Formulate Objectives*

The objective of this project is to develop a student worksheet that will help students in their learning process and improve their comprehension of the lesson, thereby dispelling their misconception that learning mathematics is challenging. Using a realistic mathematics education strategy is one option.

b. Design

Everything that required to be made in accordance with the define phase was done at this stage. The design phase involves conducting or producing the necessary items according to the standard method. The following are the outcomes of the realization in the form of a student worksheet based on Realistic Mathematics Education (RME):

- *Preparation of Making the Products*

Find and gather several reference books at this stage to use in developing the student worksheet. When creating the student worksheet, references were gathered from a variety of sources that were deemed pertinent and consistent with the chosen content.

- *Making the Fundamental Framework for Student Worksheet*

The structure for the student worksheet that will be created includes a cover, competencies to be achieved, content display, and concept maps. Additionally, materials and exercises that are customized to the five characteristics and three principles of Realistic Mathematics Education (RME) will be transformed into mathematization and mathematical modeling and displayed as an iceberg. The iceberg of students' worksheet's materials and activities is shown in Figure 2.

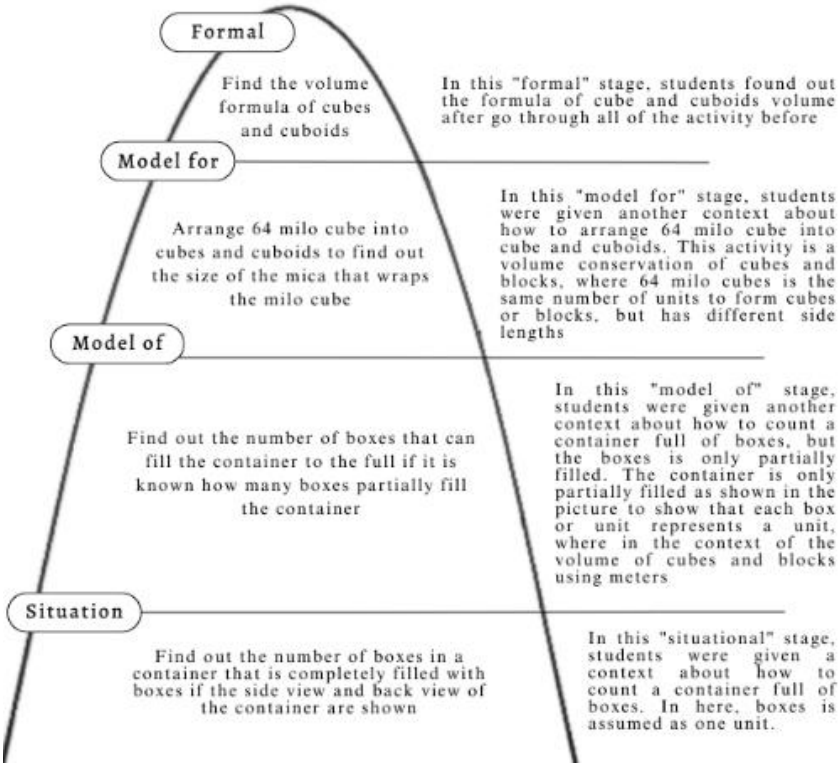


Figure 2. RME's Iceberg of Cube and Cuboid Volume Material

- *Initial Design*

The initial design of the student worksheet was created based on the manufactured iceberg after the basic foundation for the worksheet had been created.

- *Preparation of Instruments*

Instruments are prepared by creating the inquiries that will be asked on the questionnaire. The questions on the list are those that must be answered and they refer to the indicators in the questionnaire. The validation from experts and small group test both receive instrument tools.

Table 3. Questionnaire Indicators

Assessment	Subject	Indicator
Validation	Material expert	1. Feasibility of the content of the content from the worksheet 2. The suitability of presentation of the material on the worksheet with the principles and characteristics of RME
	Media expert	1. The quality aspect is seen from the usability of the worksheet 2. Design aspects seen from readability, image quality, and worksheet management quality 3. Aspects of language seen from the use of language
	Learning expert	1. Suitability of the level of ease of activity to be given to students 2. Suitability of the contents of the worksheet with the material given to students
Practicality	Students	1. The appearance of the worksheet is attractive and easy to understand 2. The activities on the worksheet relate to life so that it makes students excited to find out

c. Develop

Following the selection of the design phase, a student worksheet using the Realistic Mathematics Education (RME) on the cube and cuboid volume material will be created. Validation evaluation and a practicality assessment are conducted as follows:

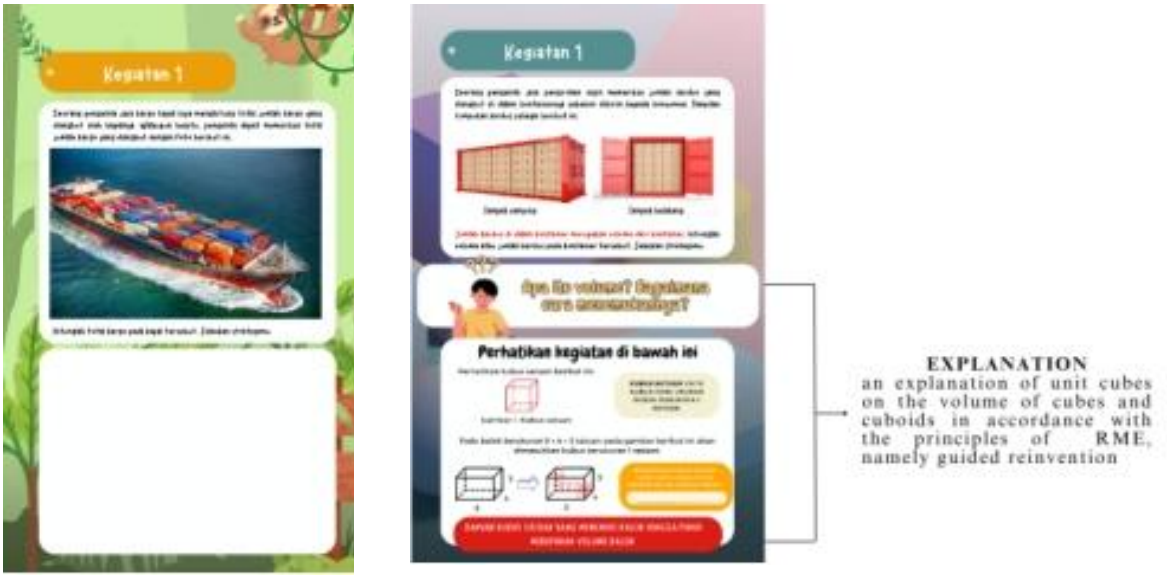
- *Validation Evaluation*

Experts in educational materials, media, and learning recommend the Student Worksheet. According to the findings of the material expert's validation, a total score of 30 was obtained, with a mean score of 3.0. According to the findings of the media expert's validation, a total score of 77 with a mean score of 3.08 was attained. The validation was then completed by a learning expert, and a final score of 29 was obtained with a mean score of 3.63. The material, media, and learning experts all made some comments and ideas, and the researcher altered the Student Worksheet in response to their feedback.

Expert B gives advice on the overall design starting from the cover page to the conclusion page that the design must be in accordance with the activities or materials provided to students so that they are connected. So, the initial design that related to the jungle theme design was replaced by geometry theme design.

For the contents of the material and activities given in the worksheet, the three experts provide some suggestions and recommendations. Expert A gives advice to pay attention to the use of language that must be technical and unambiguous so that students are not confused in working on worksheets. Then, Expert C also stated that the activities given to students were still difficult to carry out, so it was necessary to replace activities that were more relevant to students and in accordance with students' abilities.

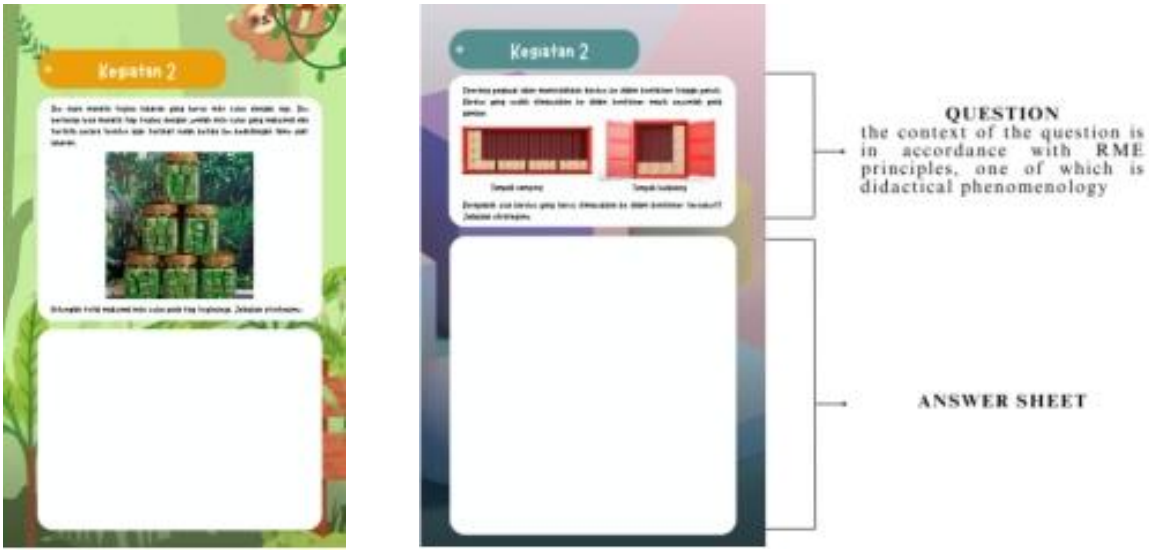
For activity 1, expert B said that the problem and image representation must be more accurate because the container ship drawings in the initial design are still ambiguous to solve. So that in activity 1, revisions were made to the context along with the pictures. Besides that, expert A also said that it is necessary to introduce the term volume at the beginning of the activity and expert C said that to get to activity 1 it needs an introduction so that students know the first step that must be taken.



(a) Before (b) After

Figure 3. Revision of the First Activity in Student Worksheet

For the second activity, expert B gave a suggestion to replace it with a problem regarding storing cardboard in containers. This problem is different from the problem in activity 1 with the aim that students will understand that a cardboard unit is a representation of the length, width, and height of a geometric figure, especially cubes and blocks.



(a) Before (b) After

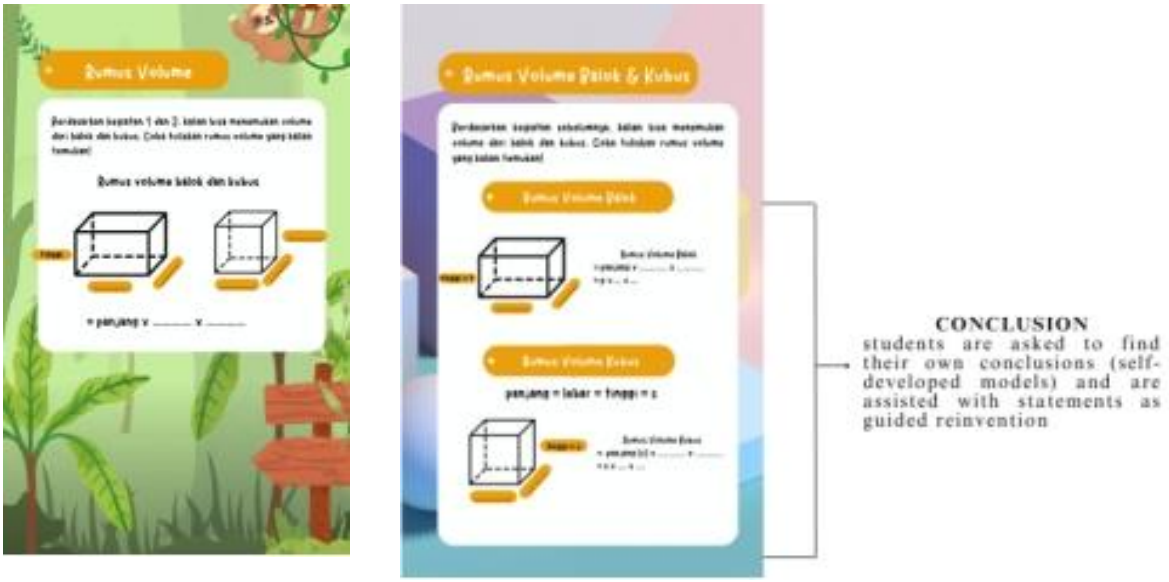
Figure 4. Revision of the Second Activity in Student Worksheet

Then the third activity also received advice from expert B because the problems in the initial design were too far away from the previous problems so it needed to be revised. expert b recommends shortening the distance by providing problems related to the conservation of the volume of cubes and blocks so that the distance between activity 2 and the conclusions to be drawn can be achieved.

(a) Before (b) After

Figure 5. Revision of the Third Activity in Student Worksheet

At the concluding stage, expert C suggests changing the appearance in the initial design so that students are not confused in concluding the results obtained after doing the activity.



(a) Before (b) After

Figure 6. Revision of the Conclusion in Student Worksheet

- *Practicality Assessment*

The study's findings also demonstrate the level of practicality shown in students' answers to the questionnaires that were distributed. Based on the students' responses, a small group test resulted in a mean score of 3.44. There are several recommendations that the worksheet be used with grade 8 kids because it is user-friendly and appealing to use for learning.

Discussion

In order to determine the difficulties that already exist at Junior High School (SMP), the researcher conducted an analysis there. The researcher then created a Student Worksheet Based on Realistic Mathematics Education (RME) based on Cube and Cuboid Volume content because of the analysis phase that the student worksheets will solve the problem. The Realistic Mathematics Education (RME) characteristics and principles are referenced in the design. Realistic Mathematics Education (RME) is characterized by five features: (1) the use of context; (2) the use of progressive mathematical models; (3) the use of student construction results; (4) interactivity; and (5) linking. The guided reinvention and progressive mathematization, didactic phenomenology, and self-developed models' principles of Realistic Mathematics Education (RME) (Van den Heuvel-Panhuizen & Drijvers, 2020).

The realistic problems context is used at the beginning of learning on the Realistic Mathematics Education (RME)-Based Student Worksheet. The use of context engages students in the problem-solving process. The outcomes of student exploration aim to develop a variety of problem-solving skills in addition to the final solution to a specific challenge. Additionally, the Realistic Mathematics Education (RME)-Based Student Worksheet's subject matter stresses the student's capacity for conceptual construction.

The validation evaluation, which comes next, was validated by media, learning, and material experts. According to the findings of the material expert's validation, the product was "Valid" with a mean score of 3.0 and a placement in the $2.5 < x \leq 3.25$ category with a percentage of 75%. The product was deemed to be "Valid" after the results of the validation by media experts showed that a mean score of 3.08 was attained and included in the category of $2.5 < x \leq 3.25$ with a percentage of 77%. The Student Worksheet was rated "Very Valid" by learning experts after receiving a mean score of 3.63 and falling into the category of $3.25 < x \leq 4$ with a

percentage of 90.63%. So, As a result of the validation, the students' worksheet received a mean score of 3.24 with a percentage of 80.92% included in the "Valid" category (Imsa-ard, 2020).

The material, media, and learning experts all made some comments and ideas, and the researcher altered the Student Worksheet in response to their feedback. The Realistic Mathematics Education (RME)-Based Student Worksheet small group test can be carried out in accordance with the ideas and opinions of the experts.

Next, by offering students questionnaires through small group testing, the levels of practicality were determined by the students' responses on the Student Worksheet. The math teacher who instructed the class assisted in choosing the students who would be the focus of the small group test which had six subject research students. The eight questions on the surveys were distributed. Based on the outcomes of a small group test, a mean score of 3.44 with a score range of $3.25 < x \leq 4$ was achieved, indicating that the product category was very practical and that it accounted for 86% of the test findings (Imsa-ard, 2020).

Based on these findings, it can be said that the Realistic Mathematics Education (RME)-Based Student Worksheet, which covered the Cube and Cuboid Volume material, received a lot of positive feedback from the students. This shows that they understand how the Student Worksheet can increase students' interest in learning by meeting high standards for a teaching tool.

CONCLUSION

According to the study and data analysis that have been done, Students' Worksheet based on RME is valid, as evidenced by the mean score 3.24 with percentage of 80.92% acquired from the average validation score of the material, media, and learning experts. With a percentage of 86% from a mean score of 3.44 acquired from the students' practicality test, the worksheet's practical results are highly useful. This demonstrates that the RME-based Students Worksheet achieved great criteria as teaching material based on the percentage of validation and practical score. In 8th grade class, the author advises math teachers to employ teaching resources in the form of Realistic Mathematics Education (RME)-Based Student Worksheets on a Cube and Cuboid Volume material.

REFERENCES

Agustina, E. N. S., Widadah, S., & Nisa, P. A. (2021). Developing Realistic Mathematics Problems Based on Sidoarjo Local Wisdom. *Mathematics Teaching Research Journal*, *13*(4), 181-201. https://files.eric.ed.gov/fulltext/EJ1332336.pdf

Hidayati, E. N., & Fauziah, A. (2019). Effectiveness of Students Activity Worksheetbased on Contextual Teaching and Learning to Improve Student' Ability in Conceptual Understanding. *Pensa: e-Jurnal Pendidikan Sains*, *7*(2), 42-48. https://ejournal.unesa.ac.id/index.php/pensa/article/view/27551

Imsa-ard, P. (2020). Motivation and Attitudes towards English Language Learning in Thailand: A Large-Scale Survey of Secondary School Students. *rEFLection*, *27*(2), 140-161. https://doi.org/10.61508/refl.v27i2.247153

Indaryanti, R. B., Harsono, H., Sutama, S., Murtiyasa, B., & Soemardjoko, B. (2025). 4D Research and Development Model: Trends, Challenges, and Opportunities Review. *Jurnal Kajian Ilmiah*, *25*(1), 91-98. https://doi.org/10.31599/na7deq07

Jeannotte, D., & Kieran, C. (2017). A conceptual model of mathematical reasoning for school mathematics. *Educational Studies in mathematics*, *96*, 1-16. https://doi.org/10.1007/s10649-017-9761-8

Kurniawan, A., Anam, A., Abdussakir, & Rofiki, I. (2019). Integrasi etnomatematika dengan model pembelajaran probing-prompting untuk melatih komunikasi matematis siswa. *Mapan: Jurnal Matematika dan Pembelajaran*, *7*(1), 1–15. https://doi.org/10.24252/mapan.2019v7n1a1

Laurens, T., Batlolona, F. A., Batlolona, J. R., & Leasa, M. (2017). How does realistic mathematics education (RME) improve students' mathematics cognitive achievement?. *Eurasia Journal of Mathematics, Science and Technology Education, 14*(2), 569-578. https://doi.org/10.12973/ejmste/76959

Oktavani, F. M., Fitri, D. Y., & Jufri, L. H. (2023). Development of Student Work Sheet Based Realistic Mathematics Education (RME) on Polyhedron Topic. *Rangkiang Mathematics Journal*, *2*(1), 43–51. https://doi.org/10.24036/rmj.v2i1.19

Palupi, E. L. W., & Khabibah, S. (2018). Developing workshop module of realistic mathematics education: Follow-up workshop. *IOP Conference Series: Materials Science and Engineering*, *296*(1), 012006. https://doi.org/10.1088/1757-899X/296/1/012006

Pratama, T. Y., Izzati, N., & Alpindo, O. (2022). Development of Interactive Learning Media with A Malay Culture Nuances and Characteristics of RME on Cube and Cuboid Materials for Junior High School. *Gantang Journal*, *7*(1), 69-82. https://doi.org/10.31629/jg.v7i1.4526

Rawani, D., Putri, R. I. I., Zulkardi, & Susanti, E. (2023). RME-Based Local Instructional Theory for Translation and Reflection Using of South Sumatra Dance Context. *Journal on Mathematics Education*, *14*(3), 545-562. https://doi.org/10.22342/jme.v14i3.pp545-562

Shodikin, A., Purwanto, P., Subanji, S., & Sudirman, S. (2021). Students' thinking process when using abductive reasoning in problem solving. *Acta Scientiae*, *23*(2), 58-87. https://doi.org/10.17648/acta.scientiae.6026

Suryani, A., Anwar, Hajidin, & Rofiki, I. (2020). The practicality of mathematics learning module on triangles using GeoGebra. *Journal of Physics: Conference Series*. *1470*(1), 012079. IOP Publishing. https://doi.org/10.1088/1742-6596/1470/1/012079

Van den Heuvel-Panhuizen, M., & Drijvers, P. (2020). Realistic Mathematics Education. In *Encyclopedia of Mathematics Education. Encyclopedia of mathematics education, 713-717.* Springer, Cham. https://doi.org/10.1007/978-3-030-15789-0_170