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DESIGN OF STUDENTS' WORKSHEET BASED ON MATHEMATICAL MODELING USING ENERGY CONVERSION CONTEXT IN GEOMETRY SEQUENCE PATTERNS

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Abstract

This research is a design research -type development study employing the ADDIE paradigm, and the implementation and assessment phases adhere to Tessmer's formative evaluation flow. This research intends to generate worksheets based on mathematical modeling of geometric sequence pattern material within the framework of energy conversion that are legitimate, practical, and have the ability to have an effect. The methods of data collection include walkthroughs, observations, interviews, and tests. The descriptive analysis of observations and interviews was conducted by monitoring the challenges and results of the process of completing student worksheets. The walk-through analysis was conducted by analyzing descriptively, i.e., by rewriting based on the validator's notes. the test was conducted after gaining an understanding of the potential consequences of the Student's Worksheet The results demonstrated that the Student's Worksheet was valid, applicable, and had the potential to affect students' mathematical modeling skills. The percentage of results on the evaluation test indicated that 54.05 percent were in the very good category and 32.43 percent in the good category, and 13 percent in the adequate area.

Keywords: Energy conversion; geometry sequences, LKPD, mathematical modeling.

Abstrak

Penelitian ini adalah penelitian design research tipe development study menggunakan model ADDIE dan pada tahap implementasi dan evaluasi mengikuti alur formative evaluation dari Tessmer. Penelitian ini bertujuan untuk menghasilkan LKPD berbasis pemodelan matematika pada materi pola barisan geometri menggunakan konteks konversi energi yang valid, praktis, dan memiliki efek potensial. Teknik pengumpulan data terdiri dari walkthrough, observasi, wawancara, dan tes. Analisis observasi dan wawancara dilakukan secara deskriptif dengan mengamati kesulitan dan temuan dari proses pengerjaan LKPD siswa. Analisis walkthrough dilakukan dengan cara menganalisis secara deskriptif dengan merevisi berdasarkan catatan validator. tes dilakukan setelah pembelajaran untuk melihat efek potensial dari LKPD yang dikembangkan. Hasil penelitian menunjukkan bahwa LKPD yang dihasilkan telah valid, praktis, dan memiliki efek potensial terhadap kemampuan pemodelan matematika siswa. Persentase skor pada saat tes evaluasi menunjukkan 54,05 % terkategori sangat baik, 32,43% terkategori baik, dan 13 % terkategori cukup.

Kata Kunci: *Barisan geometri , konversi energi, LKPD, pemodelan matematika.*

INTRODUCTION

The low PISA scores of Indonesian students from multiple OECD assessment editions (2018) demonstrate that Indonesian students' problem-solving skills in everyday life are still inadequate. This is due to the fact that students are not accustomed to

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working with non-routine questions and struggle to solve context-based questions that are transformed into mathematical problems (Wijaya, Heuvel-Panhuizen, Doorman, & Robitzsch, 2014). According to Masfufah and Afriansyah's research (2021), students are still unable to interpret level 1 and level 2 PISA questions, which are still at a lower level, and create mathematical models. Connecting formal mathematical concepts to real-world problems is a weakness of students' mathematical reasoning; therefore, tools are required to help them deal with real-world problems (Jumainisa, Darmawijoyo, & Hartono, 2019).

Mathematical modeling is the process of translating real-world issues into mathematical models so that mathematics can be used to solve them (Blum & Niss, 1991; Lange, 2006; Hartono, 2020). The model captures certain characteristics of the entity it represents and is thus a simplified representation of this entity; the process of creating this model is referred to as modeling. (Niss & Blum, 2020). The generated model can also serve as a tool for understanding problems and making predictions through simulations (Hartono, 2020).

Research conducted by Kanthawat, Supap, and Klin-eam (2019) states that students' mathematical literacy in learning geometric sequences does not function due to a lack of reflection on the part of teachers to provide interventions that help students understand problems in mathematical modeling. Research conducted Riyanto, et al (2019) In modeling the challenge of comparing the prices of different types of taxis through the use of number sequences, the need for modeling learning has not been recognized because it still resembles standard applied mathematics. In light of this, experts believe it is essential to produce a mathematical modeling Student's worksheet that assists students in using mathematical modeling to tackle common problems.

The criteria for modeling problems must be open, complicated, realistic, genuine, challenging, and amenable to resolution via the modeling process (Maaβ, 2007; Ferri, 2018). Modeling cannot be separated from other mathematical skills such as reading, speaking, designing, implementing problem-solving strategies, or working numerically (Niss, 2003; Blum & Ferri, 2009). Student independence must be maximized in modeling learning in order for students to acquire mathematical competence and develop connections inside and beyond mathematics (Blum & Leiβ, 2008; Blum & Ferri, 2009).

According to Blum (2011) The four-step modeling cycle established by the DISUM-Project, namely, understanding the problem, searching for mathematics, applying mathematics, and explaining the results, is more ideal for application in education since it can assist students who may have difficulty with the completion procedure. By incorporating modeling issues into mathematics instruction, students can increase their modeling competency, i.e. their capacity to solve daily problems using mathematical modeling. (Kaiser & Grunewald, 2015)

Student worksheets are a means of assisting and facilitating learning activities through the formation of successful interactions between students, hence increasing student involvement and enhancing learning achievement (Umbaryati, 2016). In

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addition, the Student’s Worksheet preparation process must satisfy three conditions: didactic requirements, construction requirements, and technological requirements. The developed Student’s Worksheet is deemed relevant if it fits two criteria: relevance and consistency. A Student’s Worksheet is deemed relevant if it is developed based on knowledge, and its design is deemed consistent if it is logical (Plomp & Nieveen, 2010).

RESEARCH METHODS

This study uses the ADDIE model as a design research type of development study, specifically *analysis, design, development, implementation, and evaluation* (Branch, 2009). The *Formative Evaluation* flow, which consists of 4 steps—parallel *One-To-One* and *Expert Review*, *Small Group*, and *Field Test*—is used during the implementation and evaluation stages. (Tessmer, 1993). Figure 1 illustrates the graph.

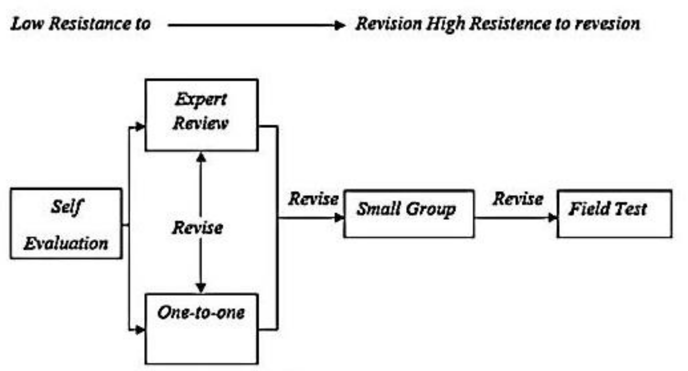

Figure 1. Formative evaluation

This research was done between 1 October and 16 November 2022. In the ONE-TO-ONE phase, examinations and interviews were administered to four Palembang 6 Public High School students who represented the population's high, medium, and low ability levels. For the expert review phase, there are three experts in mathematical modeling and walkthrough-based mathematics education. In the small group stage, the Student’s Worksheet prototype 2 was tested in groups with varying levels of ability, and interviews were done after the Student’s Worksheet was implemented. During the subsequent field test, the improved Student’s Worksheet prototype 3 was implemented in class X MIPA 2 with as many as 37 students. Following instruction, a test is administered to determine the possible impact of Student’s Worksheet on students' mathematical modeling skills.

Examining the compatibility of the Student’s Worksheet designed on the initial prototype with the modeling framework, high school curriculum, and learning geometric sequences, document analysis was conducted. The descriptive analysis of observations and interviews was conducted by monitoring the challenges and findings of the student's Worksheet work process.. Walk-through analysis was conducted by analyzing descriptively, i.e. revising based on the validator's notes. The results of this analysis were utilized to revise the researcher's Student’s Worksheet in order to get a valid Student’s Worksheet.

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RESULT AND DISCUSSION

1. Results

1.1 Analysis Stage (*Analyze*)

Researchers analyze four components of mathematical modeling during the analysis phase: student analysis, curriculum analysis, material analysis, global analysis, and context analysis.

a) Student Analysis

The importance of student analysis stems from the fact that researchers must determine the cognitive capacities of the students who will be the topic of their research. According to evidence received from mathematics teachers at SMAN 6 Palembang, the cognitive level of schoolchildren is extremely different (heterogeneous). The teacher also stated that the kids were accustomed to solving questions requiring HOTS (*Higher Order Thinking Skill*) level reasoning.

b) Curriculum Analysis

The curriculum utilized in class X at SMAN 6 Palembang is the Independent Learning Curriculum, a simplification of the 2013 curriculum. The autonomous curriculum places a greater emphasis on key content and the development of student competencies. Mathematical application and modeling is a crucial topic that is heavily emphasized in independent curriculum mathematics instruction. The learning objectives of this Student's Worksheet are as follows: 1) Students can develop patterns of geometric sequences for real-world growth problems with a certain percentage increase from the prior period., 2) Students are able to solve real-world problems requiring geometric sequence patterns and growth involving a proportion of the preceding period's increase.

c) Material Analysis

According to the results of a review of the textbooks used by students in the autonomous curriculum, the information on geometric sequence patterns does not address real-world HOTS issues such as PISA. The explored questions only provide examples of ratios of integers and do not demonstrate the concept of geometric sequences related to mathematical growth that involve percentages as ratios.

d) Context Analysis

The first thing the researcher did to establish a mathematical modeling-based Student's worksheet was to seek for current issues (*Current Issue*) that could be raised as a topic of real difficulties related to the mathematics curriculum taught in schools, so that this problem could be solved using mathematical modeling. Therefore, the researchers raised the issue of converting from using epiji gas stoves to electric stoves which have been widely discussed by the public lately.

1.2 Design Stage

At this stage, the researcher designed the problem and problem solving flow using Blum's (2011) mathematical modeling FRAMEWORK which consisted of 4 modeling stages, namely understanding task, searching, mathematics, using mathematics, dan explaining result. The context of the produced modeling questions is energy conversion, specifically decision-making on government rules on the electric stove program employing geometric sequence patterns whose ratios incorporate percentages.

1.3 Development Stage

At this level, the researcher built LKPD by creating systematic and

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procedural questions to assist students in completing the Student's Worksheet in accordance with the mathematical modeling stages. This Student’s Worksheet has covers, learning outcomes, learning objectives, a flowchart of learning objectives, directions, supplementary materials, and activities in the form of questions with blank boxes. Figure 2 depicts the Student’s Worksheet problem during its developmental stage.

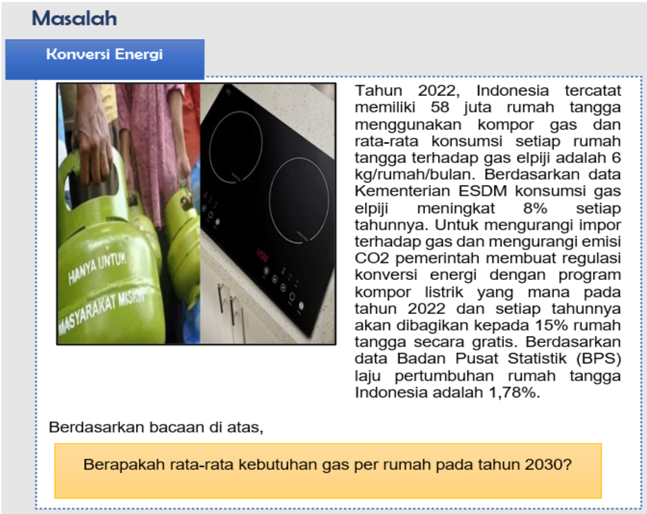

Figure 2. Worksheet’s task in development stage

1.4 Implementation and Evaluation

a. Expert Review

The created LKPD is then analyzed and evaluated by professionals in the fields of mathematical modeling and mathematics education at this step. In terms of language, substance, and constructions, the validator provided feedback and recommendations on the Student’s Worksheet that the researchers constructed based on mathematical modeling of geometric sequence patterns in the context of energy conversion. The researchers revised the produced Student’s Worksheet based on the validator's comments and suggestions. Commentary and professional advice are provided in Table 1.

Table 1. Comments and suggestions at expert review stage

No.	Expert	Comments and Suggestions
1.	Prof. Dr. Edi Cahyono	The Student’s Worksheet contains the sentences listed below. "The government is making regulations on energy conversion with an electric stove program that in 2022 and every year will be provided to 15% of households free of charge," according to the statement. The existence of LKPD makes it difficult to comprehend. In addition, the sentence is not correct and proper Indonesian. Suggestion: split the sentence into two distinct clauses. There is no phase in completing the Student’s Worksheet that involves specifying the variable in order to create a mathematical model.

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No.	Expert	Comments and Suggestions
2.	Assoc. Prof. Dr. Nila Kesumawati, M.Si.	Correcting and adjusting the learning objectives for operational verbs at the C4 cognitive level and above so that they lead to HOTs questions in accordance with the Student's Worksheet phases of work. Each image requires a unique image number and name. Students will be confused if the household growth rate is calculated, as geometric sequences serve no purpose in determining the annual gas consumption. Drawing sketches during the phase of problem analysis is quite complicated. Students' mathematical models can be complicated by multiplying the average gas consumption, population, and number of months by 12.
3.	Dr. Nyiayu Fahriza Fuadiah, M.Pd.	This setting is highly intriguing because it is a current hot topic. It's just that the line "The government is drafting laws on energy conversion for the electric stove program, which will be supplied for free in 2022 and every year thereafter" makes the question unclear. Because the unit is a house, while the 8% increase represents the increase in tons of gas use. If the direction of the query is like this, then the number of gas stoves delivered must first be translated into tons or kg. It is preferable to replace the text with "The electric stove program reduces annual gas consumption by 15%."

The criticisms and suggestions made by the validator regarding the researcher-created LKPD are displayed in Table 1. Researchers will use the validator's comments and suggestions as a basis for developing the produced prototype 1 LKPD in order to attain language, content, and construct validity. Figure 3 depicts the researcher's decision regarding the need for a revision.

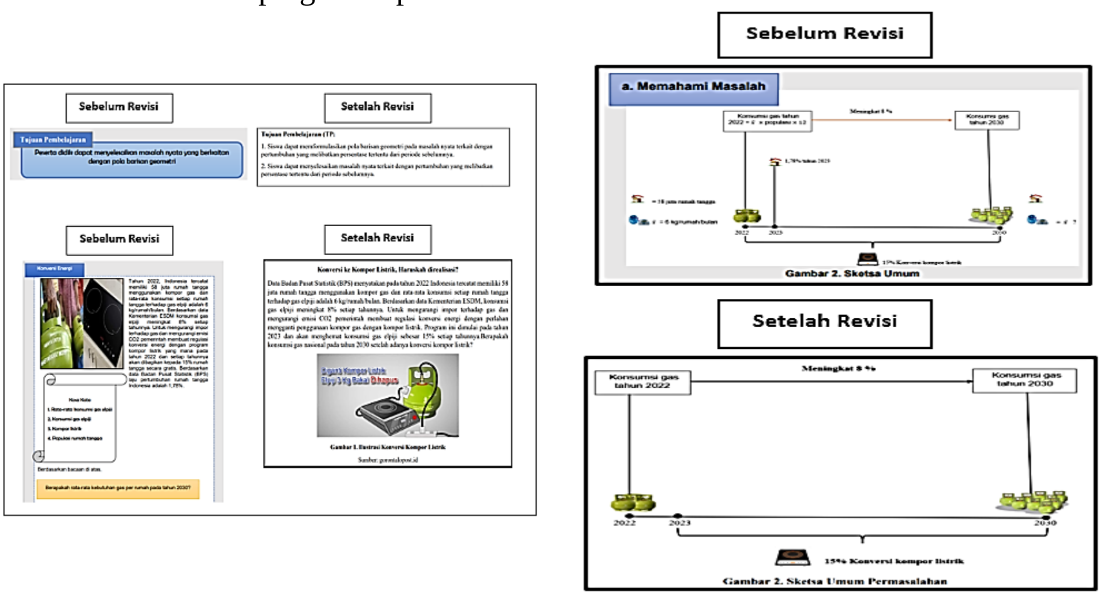

Figure 3. LKPD revision in the expert review stage

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b. One to One Stage

At the development stage, Student's Worksheet prototype 1 was also tested individually with four students with varying degrees of ability, including one student with high ability, two students with moderate ability, and one student with low ability as evaluated by the teacher.. The objective of the one-on-one phase is to determine where students struggle with each stage of mathematical modeling for Student's Worksheet. Observations were made of their work process in completing the Student's Worksheet, and interviews were done to validate the responses provided on the Student's Worksheet, the challenges encountered by students, the language used on the Student's Worksheet, and questions that were not understood. The results of the researchers' observations revealed that students still struggled to create mathematical models of issues and could not apply the concept of geometric sequences to problem-solving. With the average formula, it does not occur to students that they must search for the amount of gasoline consumed in one year. Table 2 and Figure 4 illustrate the revision decisions.

Table 2. One to one stage revision decision

No.	Worksheet elements	Revision Decision
1.	Questions at the stage of searching mathematics	Questions are clarified further so that the phase of defining variables is more understandable. This will make it simpler for pupils to comprehend the concept of geometric sequences in order to construct their mathematical models.
2.		Because many students misinterpret mathematical models when constructing them, the average gas consumption formula is eliminated.
3.		Students' formulations are facilitated by the simplification of sentences containing definitions that guide their development of mathematical models.

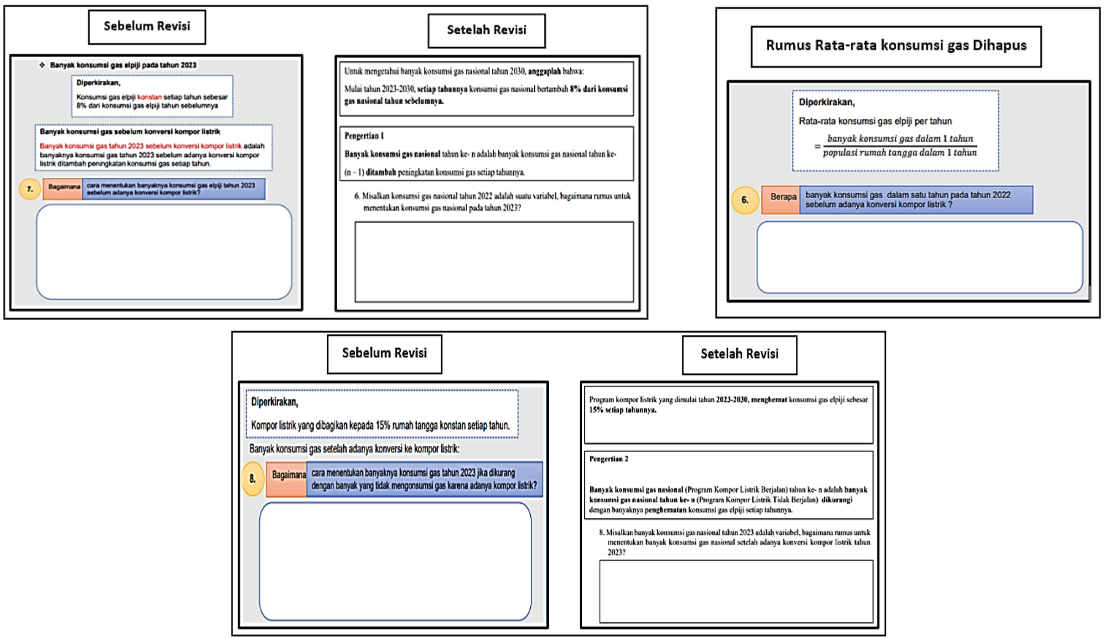

Figure 4. LKPD revision in the one to one stage

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c. Small Group Stage

At the small group stage, the researcher distributed Student’s Worksheet prototype 2 to two groups of students, one of which consisted of four students from diverse backgrounds. Each group consists of two pupils with low, medium, and high levels of ability. The purpose of the small group experiment is to evaluate the improved Student's Worksheet usability at the expert review and one-on-one stages. On November 4, 2022, the small group stage was conducted in class XI MIPA 2 of SMA Negeri 6 Palembang.

In general, students are able to work on being able to comprehend and execute every Student's Worksheet order, despite the fact that their replies are not faultless. It takes a great deal of time to work on the question orders during the phase in which students struggle to comprehend the topic. Then, during the mathematical searching phase, pupils struggle to comprehend the significance of reducing annual gas use by 15%. Therefore, the researcher provided some *Scaffolding* at this step by reminding students of the notion of %. Then, when it came time for students to interpret their mathematical conclusions in the real world, they had some trouble determining if the electric stove program could reduce gas use. Students are able to create precise mathematical models and compute the quantity of national gas consumption in 2030 if there is an electric stove program during the application of mathematics. According to the findings of interviews with students, they also had trouble comprehending the 15% reduction in gas usage. As shown in Table 3 and Figure 5, the following revision was conducted by researchers at the small group stage.

Table 3. Small group revision decision

No.	Results of Observations and Interviews	Revision Decision
1.	Students require a long time to learn the significance of the average national gas consumption to determine national gas consumption in the initial year.	The information provided in the direct question details the national gas usage for the first year. Two questions relating to data/information that facilitates problem solving are posed as a simplification of the initial, problem-understanding-stage questions.
2.	Students have difficulties comprehending the significance of a 15% reduction in gas consumption at the basic mathematics level.	The sentence redaction in the question was modified so that students' mathematical understanding are not misrepresented by ambiguity on the aim of 15% savings.
3.	Students struggle to interpret mathematical computations in order to tackle real-world situations.	The release of national gas usage data for the first year was delayed until 2020. Then, during the stages of searching for and using mathematics, students were instructed to anticipate the national gas consumption in 2030 if there were no electric stove program.

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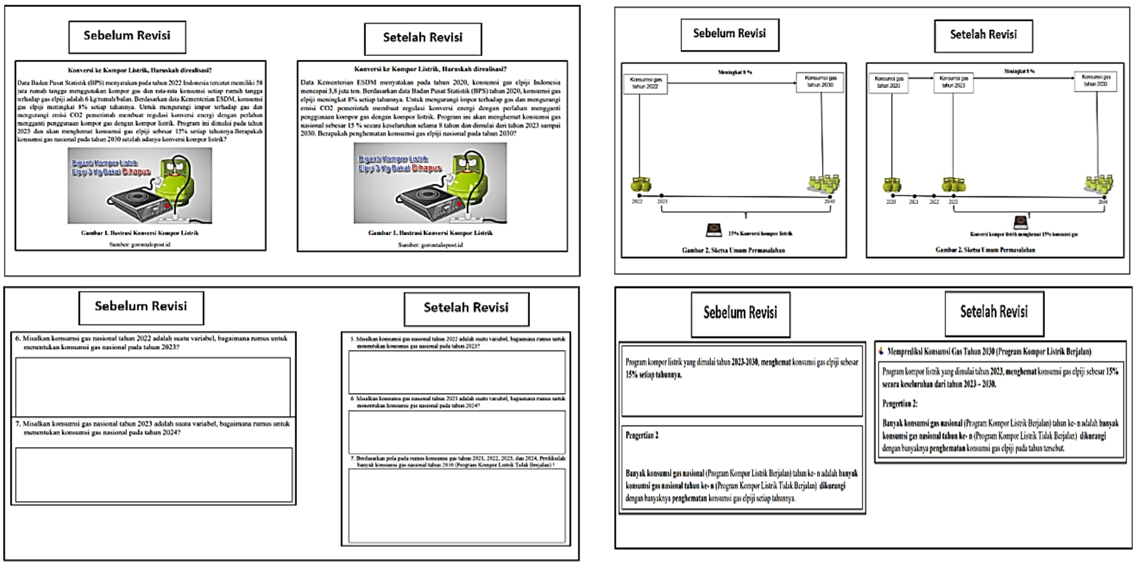

Figure 5. LKPD revision in the small group stage

d. Field Test Stage

This stage was conducted to determine the possible impact of prototype 3 Student's Worksheet after its revision in the small group stage on the mathematical modeling skills of students. This potential effect can be observed during the Student's Worksheet learning process by examining the formation of mathematical modeling indicators in student work and analyzing student responses to each level of mathematical modeling. When learning to utilize mathematical modeling Student's Worksheet, the majority of students are able to apply all phases of mathematical modeling to Student's Worksheet, and all mathematical modeling indicators are present in the answers of the majority of students.

After gaining knowledge, the researcher assessed the possible impact on Student's Worksheet based on mathematical modeling by adminis-tering a test. Evaluation questions continue to employ the framework of energy conversion and include mathematical modeling steps. The test outcomes are shown in Table 3.

Table 3. Student evaluation results

Score	Category	Percentage
86 – 100	Excellent	54,05%
71 – 85	Good	32,43 %
56 – 70	Enough	13 %
Sum		100 %

Base on the result of student evaluation in Table 3, it demonstrates that Student's Worksheet based on mathematical modeling in the context of learning geometric sequences in the context of energy conversion has the potential to improve students' mathematical modeling skills.

2. Discussion

Galbraith (2007) explains that mathematical modeling problems must have a connection to students' personal lives, that problems can be broken down into simple questions, that formulations can be made, that solutions can be interpreted in the real world, that they can be evaluated during interpretation, and that they adhere to didactic principles. Converting a gas stove to an electric stove is a contentious issue that may be expressed as a modeling challenge. According to Hartono (2020)

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Students can forecast the occurrence of an event or the solution to a problem using mathematical modeling.

This problem can be transformed into a mathematical model to determine the efficacy of this energy conversion policy, using the concept of geometric sequence patterns relating to the percentage growth of an object. The difficulty in offering modeling issues is that the instructor must possess solid subject and pedagogical knowledge in order to comprehend the offered modeling work; hence, the teacher must conduct a diagnostic to determine student comprehension. (Ferri, 2013).

According to Nieveen (2013), the validity of this Student's Worksheet is dependent on its content, constructs, and language, which are characteristics of high-quality Student's Worksheet. This mathematical modeling Student's Worksheet fits the criteria for validity, applicability, and possible effects, as demonstrated by the results reported. According to evaluation data from the one-to-one and expert review stages, pupils continue to struggle with searching mathematics. This is consistent with the results of the evaluation during the expert review stage, which indicated that the use of sentences and the information supplied in the questions remained unclear. This student's difficulty stems from their inability to comprehend the meaning of "average gas consumption." The validity of the construct aspects of Student's Worksheet must be determined by the suitability of the mathematical modeling problems to the level or ability of the students when examining the intent of the problem, and by the fact that the sentences used are straightforward and do not lead to multiple interpretations for students (Saputri & Zulkardi, 2020).

At the time of the small group evaluation administered to two groups of students, a practical Student's Worksheet was generated. Nearly all pupils are capable of completing all five phases of mathematical modeling. It's only that outside data indicate that students require a considerable amount of time to answer questions at the stage of problem understanding, namely in predicting national gas consumption in the first year. This is consistent with Blum's (2015) conclusion that students struggle with the understanding task stage. Then, at the maths stage, pupils are puzzled about the significance of reducing annual gas usage by 15%. According to the multiples, students expect it will decrease annually. Students have trouble applying the model because they are not accustomed to addressing mathematical modeling problems; thus, it is hoped that the model can be incorporated into the learning process so that students become acclimated to solving realworld problems (Jumainisa, Darmawijoyo, & Hartono, 2019).

Students have a bit of difficulty interpreting their mathematical results to solve real-world problems throughout the phase of explaining outcomes. This is because students do not consider gas use in 2030 if no electric stove conversion scheme is implemented. Mathematical modeling competency is also characterized as an individual's skill and willingness to use mathematical modeling to address real-world problems (Kaiser & Grunewald, 2015). Therefore, the most crucial step in mathematical modeling to solve everyday problems is to explain the results.

At the Student's Worksheet field test stage, the results of the small-group revision were implemented to determine the possible impact on students'

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mathematical modeling skills. The results demonstrated that all students were extremely excited and actively engaged in group discussions to address each issue on the Student's Worksheet. In addition, they aggressively requested researchers and educators to confirm their comprehension at Student's Worksheet phase. This is consistent with the findings of Ozdemir and Üzel (2012), who discovered that while students are learning to utilize mathematical modeling, they collaborate and make judgments including group members. At the point of applying mathematics, there are still organizations that incorrectly perceive the substantial reduction in gas use in 2030 if the electric stove program is implemented. The majority of students were able to comprehend the results by analyzing their math answers and concluding that there would be a savings impact if the electric stove program were implemented.

Following the lecture, the researcher administered an evaluation exam to determine the possible impact of the Student's Worksheet on the mathematical modeling skills of the students. As a result, students are able to comprehend problems, develop mathematical models, and correctly solve them. As a result of recycling legislation, the majority of pupils are able to perceive the decrease in waste output as a potential source of electricity. The majority of students displayed all markers of mathematical modeling, with 86.4% of students scoring between 70 and 100 on this evaluation question. Consequently, Student's Worksheet based on mathematical modeling of geometric sequence material in the context of energy conversion has the potential to affect students' mathematical modeling skills.

CONCLUSION AND SUGGESTION

This research generates a genuine, practical, and potentially influential mathematical modeling challenge in the area of energy conversion on geometric sequence materials. Validity of the *Student's Worksheet* is determined by its content, structure, and language. Implementation in the small group phase yields Student's Worksheet that is applicable. LKPD may potentially have an impact on pupils' mathematical modeling skills. The challenge of mathematical modeling in the context of energy conversion has a function and benefits for students in evaluating government rules that have an impact on their economic lives, and in contributing to the education of the surrounding community.

Future implementation of Student's Worksheet based on mathematical modeling must be more comprehensive in order to detect students' problems at each mathematical modeling step. This is also related to the ability to construct mathematical model.

REFERENCESS

Blum, W. (2011). Can Modelling Be Taught and Learn? - Some Answers from Empirical Research In G. Kaiser et al. (eds), Trends in Teaching and Learning of Mathematical Modelling. *Trends in Teaching and Learning of Mathematical Modelling ICTMA14* (hal. 15-30). New York: Springer. DOI: 10.1007/978-94-007-0910-2.

Blum, W. (2015). Quality Teaching of Mathematical Modelling: What Do We Know, What Can We Do? *The Proceedings of the 12th International Congresson Mathematical Education* (hal. 73-96). Cham: Springer.

ISSN 2089-8703 (Print)
ISSN 2442-5419 (Online)

DOI: https://doi.org/10.24127/ajpm.v11i4.6234

Blum, W., & Ferri, R. B. (2009). Mathematical Modelling: Can it Be Taught And Learnt? *Journal of Mathematical Modelling and Application, 1*(1), 45-58.

Blum, W., & Leiβ, D. (2008). Investigating Quality Mathematical Teaching-The DISUM Project. In Bergsten, C. et. al (Eds). *Developing and Researching Quality ini Mathematics Teaching and Learning: Proceeding of MADIF 5: The 5th Swedish Mathematics Education Research Seminar.* Malmö: Linköping: SMDF.

Blum, W., & Niss, M. (1991). Applied Mathematical problem Solving, Modelling, Applications, and Links to Other Subjects- State, Trends, and Issues in Mathematics Instruction. *Educational Studies in Mathematics, 22*, 37-68.

Branch, R. M. (2009). *Instructional Design : The ADDIE Approach.* New York: Springer. DOI: 10.1007/978-0-387-09506-6.

Ferri, R. B. (2013). Mathematical Modeling-The Teacher's Responsibility. *Conference on Mathematical Modeling* (hal. 26-31). New York: Program in Mathematics and Education, Teacher College, Columbia University.

Ferri, R. B. (2018). *Learning How to Teach Mathematical Modeling in School and Teacher Education.* Cham, Switzerland: Springer. ISBN: 978-3-319-68072-9.

Galbraith, P. (2007). *Dreaming a "Possible Dream": More Windmills to Conquer. n C. Haines, P. Galbraith, W. Blum, & S. Khan (Eds.), Mathematical Modelling: Education, Engineering and Economics. (44-62).* Chichester, UK: Horwood.

Hartono, Y. (2020). Mathematical Modelling in Problem Solving. *Journal of Physics: Conference Series, 1480*, 1 - 6.

Jumainisa, S., Darmawijoyo, D., & Hartono, Y. (2019). On Mathematical Modelling Task Using Health Context for Grade 5. *Journal of Physics: Conference Series, 1166 012024*, 1-9. DOI: 10.1088/1742-6596/1166/012024.

Kaiser, G., & Grunewald, S. (2015). Promotion of Mathematical Modelling Competency in The Context of Modelling Project. In L. Ng. hoe & N. K. E. Dawn (Eds). *Series on Mathematics Education Vol. 8, Mathematical Modelling from Theory to Practice* (hal. 21-39). Toh Tuck Link: World Scientific Publishing Co.Pte.Ltd.

Kanthawat, C., Supap, W., & Klin-eam, C. (2019). The Development of Grade 11 Students' Mathematical Literacy on Sequences and Series Using Mathematical Modelling. *Journal of Physics: Conference Series. Vol 1157, No. 2*, 1-7.

Lange, J. D. (2006). Mathematical Literacy for Living from OECD-PISA Perspective. *Tsukuba Journal of Educational Study in Mathematics, 25*, 13-35.

Maaβ, K. (2007). Modelling in Class: What do We Want The Students to Learn? Dalam C. Haines, P. Galbraith, W. Blum, & S. Khan, *Mathematical Modelling (Eds), Education, Engineering, and Economics* (hal. 65-78). Chischester: Horwood Publishing.

Masfufah , R., & Afriansyah, E. A. (2021). Analisis Kemampuan Literasi Matematis Siswa Melalui

DOI: https://doi.org/10.24127/ajpm.v11i4.6234

Soal PISA. *Mosharafa: Jurnal Pendidikan Matematika*, 10(2), 291-300.

Nieveen, N. (2013). *Formative Evaluation in Educational Design Research: in. An Introductional to Educational Design Research. (89-102)*. Enschede: Netherlands: SLO. Netherlands Institute fo Curriculum Development.

Niss, M. (2003). Mathematical Competencies and The Learning of Mathematics: The Danish KOM Project. In Gagatsis, A/papastavridis, S. (Eds). *3rd Mediterranean Conference on Mathematical Education* (hal. 115-124). Athens: The Hellenic Mathematical Society.

Niss, M., & Blum, W. (2020). *The Learning and Teaching of Mathematical Modelling*. London & New York: Routledge.

OECD. (2018). *PISA 2018 Insight and Interpretations*. Paris: OECD.

Özdemir, E., & Üzel, D. (2012). Student Opinions on Teaching Based on Mathematical Modelling. *Procedia – Social and Behavioral Sciences*, *55*, 1207-1214.

Plomp, T., & Nieveen, N. (2010). *An Introduction to Educational Design Research. Proceedings of Seminar Conducted at The East China Normal University, Shanghai (PR China)*. Netherland: SLO Netherland Institute for Curriculum Development.

Riyanto, B., Zulkardi, Z., Putri, R. I., & Darmawijoyo, D. (2019). Senior High School Mathematics Learning Through Mathematical Modelling Approach. *Journal on Mathematics Education*, 425-444.

Saputri, N. W., & Zulkardi, Z. (2020). Pengembangan LKPD Pemodelan Matematika Siswa SMP Menggunakan Konteks Ojek Online. *Jurnal Pendidikan Matematika, 14*(1)1-14. DOI: https://doi.org/10.22342/jpm.14.1.6825.1-14.

Tessmer, M. (1993). *Planning and Conducting Formative Evaluations*. London: Kogan Page Limited (Online).

Umbaryati, U. (2016). Pentingnya LKPD pada Pendekatan Scientific Pembelajaran Matematika. *PRISMA, Prosiding Seminar Nasional Matematika* (hal. 217-225). Semarang: UNNES.

Wijaya, W., Heuvel-Panhuizen, M., Doorman, M., & Robitzsch, A. (2014). Difficulties in Solving Context Based (PISA). *Journal The Mathematics Enthusiast, 11*(3), 555-584.