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THE DEVELOPMENT OF REALISTIC MATHEMATICS EDUCATION-BASED STUDENT WORKSHEETS TO ENHANCE HIGHER-ORDER THINKING SKILLS AND MATHEMATICAL ABILITY

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ABSTRACT

This study aims to provide educational resources in the form of worksheets based on Realistic Mathematics Education (RME) principles and focus on the topic of equal fractions. The main criteria for these resources are validity, feasibility, and effectiveness. The development methodology employed in this study is the ADDIE model, which encompasses the Analysis, Design, Development, Implementation, and Evaluation stages. The participants of this study consisted of 14 pupils enrolled in class IV at SDM Alam Surakarta. The assessment tools employed consisted of assessments on student learning outcomes about equivalent fractions and supplementary materials in the form of questionnaires, interview guides, and observation sheets. The examination of the data reveals that the learning tools have achieved a high level of validity, falling inside the extremely valid category, with an average score of 4.26. The feasibility test for the LKS, conducted by the assisting instructor, yielded an average score of 4.4. The pupils' performance on the LKS assessment yielded an average score of 4.89, placing them in the "very feasible" category. The classical student learning outcomes achieved a completeness of 85.71%, as evidenced by an average score of 80.35. Notably, 12 students attained a complete score. There is a noticeable upward trend in student engagement during each learning session. The findings from the data analysis conducted on instructors' competencies in managing RME-based learning revealed an average score of 92, indicating a high level of proficiency. Students who were qualitatively integrated into the eligibility questionnaire also expressed positive responses. Therefore, learning tools based on Realistic Mathematics Education (RME) exhibit high validity, feasibility, and effectiveness in educational settings, as they have been empirically demonstrated to enhance students' mathematical proficiency.

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1. INTRODUCTION

Education is often regarded as a pivotal area in the advancement of a nation, encompassing the cultivation of high-caliber human capital. Mathematics is a discipline that possesses the potential to help towards the amelioration of the deficiency in human resources quality (Sari, 2018; Widodo et al., 2023). The acquisition of mathematical knowledge has the ability to foster the development of students' abilities to confront forthcoming obstacles. Nevertheless, the academic performance of students in mathematics, particularly those in Indonesia, remains subpar. According to the findings of the 2018 edition of The Program for International Student Assessment (PISA), Indonesia attained a position of 74th among the 79 nations that took part in the assessment. The average score achieved by Indonesian students in the domain of mathematics was 379 (OECD, 2019; Susetyo et al., 2022).

Mathematical ability, also referred to as mathematical skill, pertains to an individual's capability to engage in a range of cognitive tasks such as mental processing, critical thinking, analysis, and problem-solving, particularly within the domain of mathematics (Widarti, 2013). The ability to think consists of Lower Order Thinking Skills (LOTS) which includes the ability to remember, understand, and apply and Higher Order Thinking Skills (HOTS) which includes the ability to analyze, evaluate, and create which these abilities are mathematical abilities that are indispensable for students to master because of the low mathematical ability in Indonesia (Qasrawi & BeniAbdelrahman, 2020; Suryapuspitarini et al., 2018).

Higher-order thinking involves students' ability to do analysis, evaluation, and creation (Kusumaningtyas et al., 2024). Within the field of Higher Order Thinking Skills (HOTS), cognitive processes are categorized into several tasks, including analysis, synthesis, and assessment. In the realm of science, it is noteworthy that HOTS encompasses conceptual knowledge, procedural understanding, and metacognitive abilities. Hence, the enhancement of mathematical proficiency can be facilitated by employing Higher Order Thinking Skills (HOTS). In addition to being focused on higher-order thinking skills (HOTS), mathematical talents are anticipated to encompass the capacity to engage in mathematization and representation processes, which are both pertinent to real-world or contextual situations, but in this case the orientation of HOTS has not been determined through what so that there is a need for specifications, for example through learning mathematics that is contextual or using everyday contexts (Widarti, 2013). The incorporation of real-life contexts in mathematics education holds significant value for students' learning experiences, as it allows for direct engagement with authentic events and facilitates the development of mathematical knowledge and skills. One pedagogical technique that can support this objective is known as realistic mathematics learning (RML) or realistic mathematics education (RME)-based mathematics learning.

Realistic Mathematics Educational (RME) is one of the right learning methods to be applied to mathematics learning, but unfortunately the application of RME is still very broad in scope so there needs to be a simpler specification (Ningsih, 2013), the utilization of the Realistic Mathematics Education (RME) method enables educators to develop instructional strategies that facilitate classroom engagement, fostering student dialogue, deliberation, and the exploration of ideas, concepts, and skills. Comprehend and grasp the subject matter. RME utilizes a student-centered approach that incorporates contextual learning, as discussed by Batul et al. (2022) and Herutomo et al. (2020). The implementation of Realistic Mathematics Education (RME) has been found to have a positive impact on students' interest and excitement towards the subject of mathematics, as evidenced by studies conducted by Sa'id et al. (2021) and Saleh et al. (2018). According to Nurkamilah et al. (2018), the idea

of Realistic Mathematics Education (RME) posits that students directly explore mathematics in order to foster an understanding that mathematics is relevant to real-life situations.

The concept of Realistic Mathematics Education (RME) is grounded in the notion that mathematics not only plays a significant role in everyday life, but also encompasses guided rediscovery, the study of natural events, and the construction of personal models (Prahmana & D'Ambrosio, 2020). According to Muhtarom et al. (2019), the use of a collaborative approach in implementing the three principles of Realistic Mathematics Education (RME) can enhance students' comprehension of topics by facilitating their ability to interpret different representations. The utilization of contextual issues in mathematics education has been found to foster the cultivation of higher-order thinking skills (HOTS) among students, namely in the areas of analysis, evaluation, and creation (Fatimah & Lubis, 2021).

The successful execution of the learning process undeniably necessitates the provision of effective learning resources. Similarly, the implementation of Realistic Mathematics Education (RME) necessitates the utilization of suitable instructional resources in order to effectively attain educational goals. The learning tool comprises a Learning Implementation Plan (RPP) and Student Worksheets (LKS). The RPP, or Rencana Pelaksanaan Pembelajaran, is a preliminary instructional design created by the instructor prior to implementing the teaching and learning process in the classroom. With decent and up-to-date mathematics learning sets, the material delivery will be more readi- ly accepted by students (Ishartono et al., 2023). On the other hand, the LKS, or Lembar Kerja Siswa, serves as a supplementary tool for facilitating learning activities (Irnawati et al., 2018). Nevertheless, it is important to acknowledge that there exist learning tools that are not tailored to the specific requirements of pupils, and educators have yet to cultivate their own lesson plans, instead relying on those readily available on the internet. Regarding LKS, the educational institution has refrained from utilizing them as a means of academic assistance.

The significance of directing attention towards the advancement of RME-based learning tools cannot be overstated, as it holds the potential to enhance the overall quality of the learning experience. According to a study conducted by Simamora et al. (2022), it has been demonstrated that the utilization of learning aids grounded in a realistic mathematical framework has the potential to enhance students' problem-solving skills and foster their capacity for independent learning. According to the research conducted by Sari and Sari (2019), it has been suggested that learning technologies based on Realistic Mathematics Education (RME) can serve as viable alternatives for teachers in delivering instructional material, with the aim of enhancing student learning results. According to a study conducted by Sari et al. (2021), the utilization of RME-based learning tools has been found to enhance student learning results. The utilization of learning tools employing the Realistic Mathematics Education (RME) method has been found to have a substantial impact on students' computational thinking proficiencies, hence fostering increased engagement and participation in the teaching and learning process. According to the study conducted by Batul et al. (2022), The utilization of RME-based learning tools has been observed to have a favorable effect on the process of learning. Based on the previous description, researchers consider the need for the development of learning tools in the form of RME-based LKS to improve HOTS-oriented mathematical skills, because through RME-based LKS can support learning that uses contextual problems can encourage students to develop the ability to analyze, evaluate, and create. These abilities are Higher Order Thingking Skills (HOTS) part of mathematical abilities that must be improved in order to improve students' mathematics learning achievement in Indonesia which is still classified as a low level.

2. METHOD

The research being referred to is Research and Development (R&D), which encompasses a systematic approach or series of actions aimed at creating a novel product or enhancing an already existing one, with the ability to be documented and quantified (Sutama, 2019). The development model used is the ADDIE model whose stages have been adapted according to the needs of this research, as described by Sari and Sari (2019). The ADDIE model is a pedagogical framework that assists educators in constructing efficacious instructional designs for various educational materials. The selection of this model aligns with the research objectives established by the researcher. The ADDIE model is comprised of five distinct stages, namely Analysis, Design, Development, Implementation, and Evaluation, as visually depicted in Figure 1.

Figure 1. ADDIE Model Stages

The participants in this study were a group of five individuals who possessed expertise in the respective fields of topic content, learning design, and learning medium. The participants in the final study comprised a group of 14 fourth-grade children from SD Alam Surakarta. Data obtained from formative evaluation can be categorized into two main components: (1) evaluation data related to test results on HOTS-oriented subject matter content, learning design, and learning media, and (2) evaluation data obtained from test results provided by teachers and students. The methodology used in this study includes the use of observation and questionnaires as data collection methods. Questionnaire sheets serve as a means of collecting data from a variety of individuals, including subject matter experts, learning design experts, learning media experts, teachers, and students, to gain valuable insights and feedback. Ultimately, the data underwent both qualitative and quantitative descriptive analysis.

During the initial phase, referred to as the analysis stage, an examination is conducted on the identified competencies, student characteristics, and learning materials. Subsequently, the subsequent phase entails the design stage. The current stage encompasses three key components: preliminary activities for product development, establishment of the fundamental structure for educational resources, and development of evaluation techniques. The subsequent level in the process is the third stage, which is commonly referred to as the product development stage. The produced product is an educational aid for mathematics learning that focuses on higher-order thinking skills (HOTS). Specifically, it is referred to as Student Worksheets (LKS). Subsequently, the process of product validation is conducted by validators, specifically lecturers and teachers, who employ assessment instruments.

The implementation stage represents the fourth phase in the process. During this phase, product utilization trials are conducted subsequent to modifications that have been implemented in response to evaluations conducted by experts. Experiments were conducted on cohorts of students in order to assess the efficacy of the product under development and to gather feedback for the subsequent phase of revision. Following the acquisition of test findings and consultation with specialists, the subsequent phase entails the evaluation of the product and potential revision, if deemed essential.

3. RESULT AND DISCUSSION

3.1. Results

3.1.1. Analysis Phase

During the analysis phase, researchers will conduct an examination of three key elements, namely the analysis of identified competencies, analysis of student profiles, and analysis of learning materials.

Competencies Analysis

The competence study revealed that SD Alam Surakarta encompasses the core competencies and fundamental competencies outlined in the revised 2017 curriculum, which is based on the 2013 curriculum. These core competencies consist of four key areas, including spiritual attitudes, social attitudes, knowledge, and abilities. Spiritual and social attitude competencies are acquired by implicit learning, whereas knowledge and skills competencies are structured into Basic Competencies (BC). Table 1 presents the findings of the Knowledge and Skills Development analysis and the Competency Achievement Indicators (CAI) for the equivalent portion material, as per the revised 2013-2017 elementary school curriculum syllabus.

Table 1. BC and GPA in fraction material for class IV elementary school

Basic Competencies		Competency Achievement Indicators	
3.1	Explaining equivalent fractions with concrete pictures and models	3.1.1	Writing equivalent fractions with concrete pictures and models
		3.1.2	Analyzing equivalent fractions with concrete pictures and models
		3.1.3	Making conclusions about several equivalent fractions from a fractional form
4.1	Identifying equivalent fractions with concrete pictures and models	4.1.1	Presenting the results of identifying equivalent fractions with pictures and concrete models
		4.1.2	Presenting solutions to problems related to equivalent fractions by multiplying or dividing the numerator and denominator by the same number.
		4.1.3	Solving problems related to equivalent fractions

Analysis of Students Profile

Moreover, the findings derived from the examination of student characteristics are as follows: a) There exists variability in students' comprehension and receptiveness towards the learning process, b) The composition of students is diverse due to their distinct backgrounds, c) In terms of the financial status of students' parents, 86% belong to the upper economic stratum while 14% fall under the middle-class category, d) Students demonstrate inadequacies in their proficiency to solve mathematical problems.

Analysis of Learning Material

The learning tools will consist of educational materials that focus on fractions, specifically those that align with the 2017 revised edition of the student book and teacher's book for class IV primary school, as outlined in the 2013 curriculum. The examination of equivalent fractions, as analyzed through Bloom's revised taxonomy, reveals that the

dimensions of knowledge encompass several key aspects. These include: 1) Factual knowledge, which pertains to the fundamental elements of fractions, as well as the comprehension of their meaning through written/symbolic representations, visual depictions, and tangible objects; 2) Conceptual knowledge, which involves a deep understanding of fractions as a concept, as well as the ability to identify equivalent and non-equivalent fractions; 3) Procedural knowledge, which encompasses the techniques employed to alter the form of fractions, such as determining equivalent fractions through the division or multiplication of both the numerator and denominator by the same value; and 4) Metacognitive knowledge, which relates to the capacity to solve contextual problems that are directly connected to the subject matter of equivalent fractions.

3.1.2. Design Phase

Activities during the design phase encompass the preparation and conceptualization of the product. Prior to commencing the production process, researchers conducted a comprehensive review of relevant literature from several sources to acquire pertinent information for reference purposes and as a source of direction. Subsequently, the researcher ascertained the designation of the educational instrument, specifically an RME-centered learning tool focusing on equivalent fractions, intended for fourth-grade students at SD Alam Surakarta, in the format of a Learning Activity Sheet (LKS).

LKS are formulated on the foundation of fundamental competencies. The fundamental structure of LKS encompasses several components, including the LKS cover, student identification, general instructions, BC (Basic Competencies), CAI (Competecies Achievement Indicators), learning objectives, activities, activity objectives, activity steps, and practice questions. The LKS design, as depicted in Figure 2, has been designed.

Figure 2. Design of learning activity sheet (LKS)

The created Learning Activity Sheet (LKS) is based on the Realistic Mathematics Education (RME) and incorporates Higher Order Thinking Skills (HOTS). The principles of RME and HOTS exhibit a significant correlation. The RME concept pertains to the guided rediscovery process, when students engage in the selection and organization of acquired

material. It might be argued that this principle aligns with the HOTS level 4 indicator, which pertains to the capacity to dissect concepts into multiple constituents and establish connections among these constituents in order to comprehend the notion holistically. The assessment indication at the fifth level of higher-order thinking skills (HOTS) pertains to the capacity to assess the extent of something by utilizing established norms, criteria, or benchmarks that are pertinent to the second principle of the Program for International Student Assessment (PISA). This involves students being able to evaluate or verify the accuracy of a given fact within a genuine situation by means of learning phenomena. During the process of evaluation and testing, it is customary to rely on established norms, criteria, or benchmarks. It can be posited that the second principle of RME is intricately linked to the HOTS indicator at level 5. The final concept of the RME framework pertains to the construction of one's own models, which aligns with the HOTS level 6 indicator of the capacity to integrate parts into a novel and comprehensive shape, or to generate creative creations. In the realm of education, it has been demonstrated that pupils possess the ability to develop strategies for problem-solving that are aligned with authentic contexts.

In addition to this, there exist many designs pertaining to the instruments required for the development of LKS. These designs encompass LKS validation sheets, which are evaluated by material experts and media experts, as well as assessment sheets that are completed by students.

3.1.3. Development Phase

During this phase, the validation process to determine the practicality of the LKS product will be conducted. The average combined score of five validators was calculated to be 4.3, falling within the category of high validity. In order to ensure that the learning tools being created align with the indications of Realistic Mathematics Education (RME)-based learning tools. Nevertheless, despite the involvement of five validators, there were still numerous comments and ideas put forth with regards to enhancing the supplied learning resources. The subsequent data presents the outcomes of LKS validation conducted by a panel of five validators, including the cumulative scores and the mean LKS validation score.

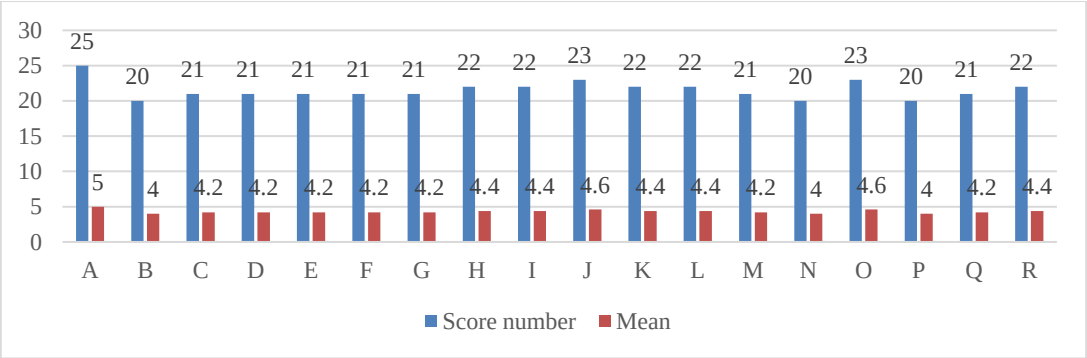

Figure 3. Result of five expert validation on LKS

Description of aspects assessed:

A. There is a student identity to make administration easier
B. Conformity of LKS indicators with basic competencies
C. Suitability of LKS learning objectives with Competency Achievement Indicators
D. Presenting LKS activities requires students to learn actively
E. The activities in the LKS are in accordance with the learning objectives
F. The activities in the LKS provide sufficient space for students to solve problems/questions

G. The use of language in LKS is appropriate to the development of grade 4 students
H. Sentence structure in simple worksheets
I. The sentence structure in the worksheet is easy for students to understand
J. The appearance of the LKS is attractive
K. Contextual problems in LKS are taken from real problems in everyday life
L. There are contextual problems in the LKS
M. Students can understand the material contained in the LKS
N. Students can independently complete the activities contained in the LKS
O. Activities in the LKS allow students to work in groups/discuss
P. There are problems in the worksheet that require students' higher analytical skills to answer them
Q. The activities in the worksheet require students to use information to solve problems
R. There are activities in the LKS that process and apply information

The results of the data analysis in Figure 3 found that the LKS is valid because it can facilitate teachers both in making administration and in assessment, in addition to making it easier for students to learn material that is in accordance with basic competencies with contextual problems so as to improve HOTS abilities in students.

3.1.4. Implementation Phase

Following the validation and enhancement of RME-based learning aids in the form of LKS, the subsequent phase involves the implementation of product trials and assessments of product feasibility. These activities are conducted by students who serve as LKS users, as depicted in Table 2.

Table 2. Product feasibilty

No	Product	Mean	Decision
1.	LKS	4.645	Very Feasible

The data presented in Table 2 reveals that the average score achieved by students in assessing the applicability of LKS is 4.645. The RME-based learning tool designed for equivalent fraction material has demonstrated its validity and suitability as a support aid for mathematics learning in fourth-grade classrooms at SD Alam Surakarta.

In interpreting qualitatively the average number of each aspect based on the criteria shown in the Table 3.

Table 3. Conversion of quantitative data to qualitative feasibility

Mean	Decision
$4.2 < X \leq 5$	Very Feasible
$3.4 < X \leq 4.2$	Feasible
$2.6 < X \leq 3.4$	Enough Feasible
$1.8 < X \leq 2.6$	Less Feasible
$X \leq 1.8$	Very Less Feasible

In relation to the efficacy of the LKS based higher-order thinking skills (HOTS) produced, the findings indicate the following: 1) there was an improvement in the

comprehensiveness of learning outcomes which means there is an increase in ability higher-order thinking skills (HOTS), 2) student engagement demonstrated a favorable classification, and 3) students responded positively to the LKS. The subsequent data represents the initial and post-learning scores of students, together with a graphical representation illustrating the progression of student learning results.

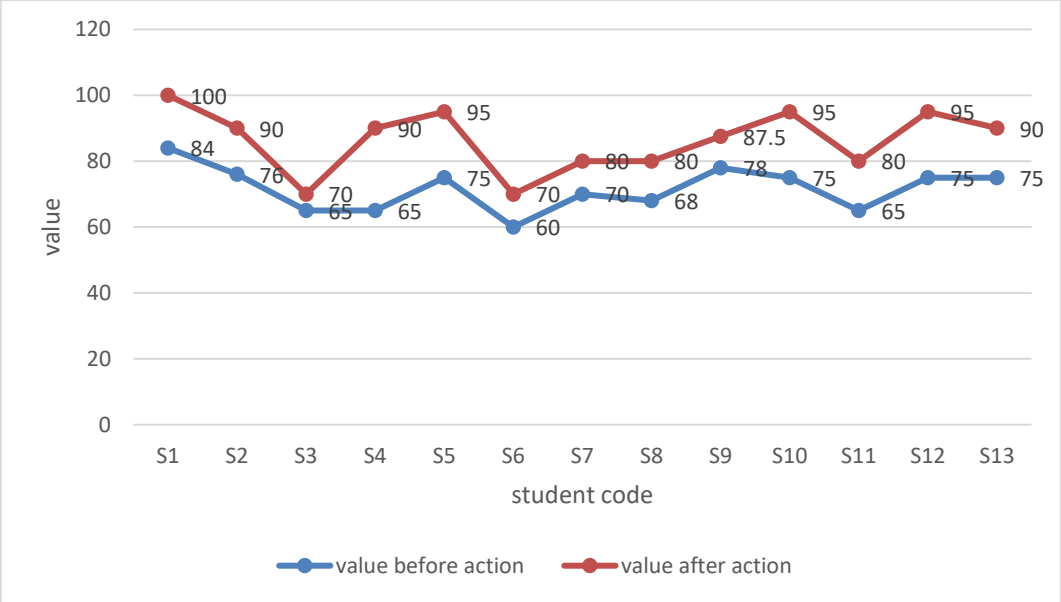

Figure 4. Students profile before and after using LKS

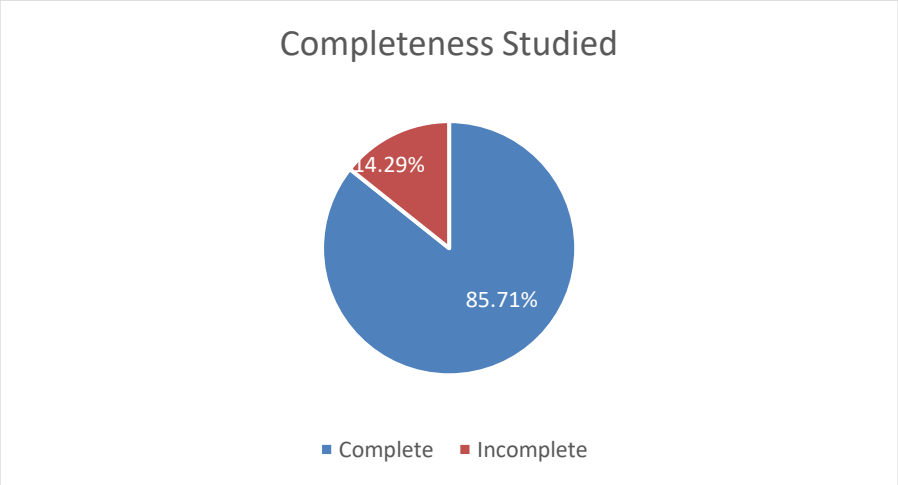

Figure 5. Student achievement profile

Based on the results of the analysis of students' scores before and after the action as Figure 4, the average math score before and after the action with HOTS-oriented realistic mathematics learning was 80.35. This indicates that there is an increase in the average mathematics learning outcomes in students by 5.28. From the results of data analysis of student learning outcomes shown in Figure 5, the completeness of student learning outcomes classically amounted to 85.71% of students who completed or obtained scores above 75 out of a maximum score of 100. Thus, HOTS-oriented realistic mathematics learning tools are effectively used for learning fractional material mathematics worth grade 4 elementary school because it can improve student learning outcomes.

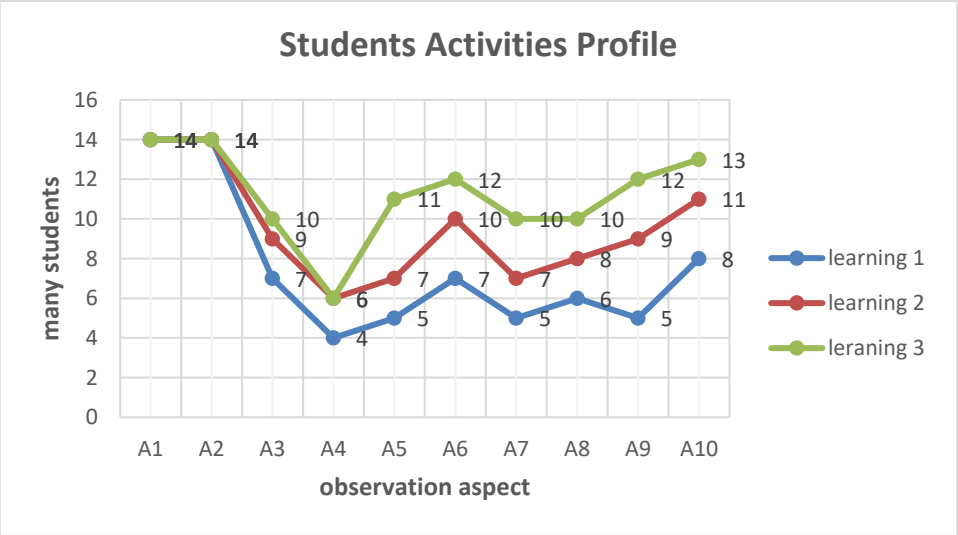

Figure 6. Students activites profile

Description of Observation Aspects:
A1 : Be present on time during learning
A2 : Be orderly in praying together before learning begins
A3 : Pay attention to the teacher's explanation
A4 : Ask about lesson material that you don't understand
A5 : Active in class group discussions
A6 : Actively working together in groups
A7 : Ask the teacher for instructions/suggestions/guidance in working on LKS questions
A8 : Dare to express your opinion
A9 : Dare to present in front of the class
A10: Collect worksheets on time

According to the findings of the data analysis, the assessment of the teacher's competence in facilitating learning through the implementation of Realistic Mathematics Education (RME) yielded an average score of 92 (indicating a high level of proficiency) for all three components: preparatory activities, core activities, and closing activities (see Figure 6). The RME-based mathematics learning tool, known as LKS, has proven to be a valuable resource for teaching fourth-grade elementary school students about fractions. This tool has been found to enhance student learning outcomes in mathematics.

3.1.5. Evaluation Phase

There remain aspects of the LKS that necessitate evaluation, as per the implementation stages. During the evaluation phase, the product undergoes final adjustments based on the suggestions and information received from users and students during the deployment stage. Despite the favorable reception of the generated worksheets by students, there remains a need to address some student responses through additional educational interventions.

3.2. Discussion

The presence of educational resources within the instructional process holds significant importance for educators. Prasetyo and Senam (2011) posits that learning tools

serve as instructional aids and guidance for educators in facilitating the learning process. According to Daryanto and Dwicahyono (2014), learning devices serve as a means of teacher preparation prior to the execution of the learning process. Consequently, the presence of learning devices significantly facilitates the implementation of the learning process. This suggests that the provision of learning gadgets is crucial for both teachers and students as tools for facilitating learning, hence enhancing the likelihood of achieving optimal student learning outcomes. Moreover, the integration of practical situations and hands-on learning outside of the traditional educational setting can successfully foster student inquisitiveness and augment their analytical, imaginative, and innovative cognitive capacities. According to Rohaeti et al. (2023), this particular strategy enhances the cultivation of mathematical intelligence among students, going beyond mere intellectual capacity. This is in line with the importance of developing learning tools in this research, in this reseach create mathematical learning aids centered on Realistic mathematical Education (RME).

The objective of this study is to create mathematical learning aids centered on Realistic mathematical Education (RME) principles. Specifically, the focus is on developing worksheets that cover fourth-grade elementary school subject related to fractions. The purpose is to ensure that these worksheets are very feasible for facilitating learning in the classroom setting. LKS is said to be very feasible because based on qualitative and quantitative feasibility analysis shows an average in the very feasible category. Learning Kits (LKS) are designed in a manner that aligns with the fundamental principles of effective educational aids. The worksheets should be designed in a visually appealing manner to capture the attention and foster enthusiasm among students for the learning process.

Numerous prior investigations have been conducted to examine the advancement of learning tools based on Realistic Mathematics Education (RME). In this study, Sari and Sari (2019) created educational resources including of lesson plans, worksheets, and final exam questions for junior high school arithmetic topics. The researchers confirmed the validity and effectiveness of these learning aids. Additionally, Marlinda and Wijaya (2018) did a study wherein they created educational resources, specifically lesson plans and worksheets, utilizing the Realistic Mathematics Education (RME) approach. These resources were designed to address the concept of flat-sided spatial building materials and were evaluated based on established criteria to ensure their appropriateness for instructional purposes. The aforementioned studies suggest that learning aids based on RME (Realistic Mathematics Education) can serve as a viable option for implementation in educational settings.

The product generated in this study has met the requirements for being highly suited for use. Additionally, the learning tools that have been developed also satisfy the requirements for effectiveness in various aspects, including the comprehensiveness of student learning outcomes, student engagement in the learning process, the teacher's capacity to facilitate learning, and student answers. These tools have the potential to enhance student learning outcomes. According to the findings of a study conducted by Shandy (2016), the adoption of the RME approach was found to have a positive impact on the academic achievements of fourth-grade children in Sukasari District, located in Bandung City. Based on the findings of this study, it was observed that the mean test result score in cycle I was 70.6, accompanied by a completion rate of 62%. In cycle II, the average score increased to 88, with a corresponding completeness rate of 87%. This shows that there is an increase in achievement or learning outcomes through the RME approach. Similarly, based on the findings of Jarmita and Hazami (2013), it was determined that the learning outcomes of students in the domain of multiplication were deemed satisfactory, as indicated by a classical learning completeness rate of 83.8%. Furthermore, the students' engagement in learning activities was found to be optimal, with a percentage of 86.5% meeting the ideal time allocation. These studies support the results of this research where through RME-based

learning tools can improve student learning outcomes or it can also be said to improve students' mathematical abilities.

Upon careful examination of the graph depicting student engagement in the context of learning, it becomes evident that there is a discernible upward trend across all observed dimensions. This suggests that RME-based mathematics learning might be considered as a viable choice for implementation in the context of mathematics education. According to the findings of Musrifah (2020), it was determined that the implementation of Realistic Mathematics Education (RME) in teaching congruence at MTs Negeri 2 Temanggung resulted in a significant improvement in student engagement and academic performance. According to the findings of Oknisih et al. (2021), the implementation of the Realistic Mathematics Education (RME) approach resulted in a significant increase in students' learning activity in the context of Class IV fractional content at Kalijering State Elementary School. Specifically, the researchers saw a notable improvement from 44% to 93.75% in students' engagement with the subject matter. According to the findings of a study conducted by Ella and Syukron (2015), the utilization of the Realistic Mathematics Education (RME) learning model was found to be successful in facilitating the learning of mathematics, specifically in the areas of Systems of Linear Equations in Two Variables (SPLDV) and Systems of Linear Equations in Three Variables (SPLTV). The study focused on students in class X UPW 2 at SMK Negeri 6 Surabaya. Based on the findings of the study, it was determined that the teacher's aptitude for instructional management fell within the "very feasible" range, with a score of 3.81. Additionally, student activities were classified as "active" due to their alignment with the instructional objectives and their contribution to the teaching and learning process. In addition, it is noteworthy to mention that the positive category encompasses students' reactions towards RME learning. Moreover, it can be asserted that classical student learning outcomes have been attained with a commendable level of completeness, reaching 93.55%.

4. CONCLUSION

The study resulted in the development of an educational tool utilizing RME principles, namely in the form of worksheets focusing on equivalent fractions. These worksheets were designed for implementation among fourth-grade students at SD Alam Surakarta. The LKS product, based on RME, was formulated through the utilization of the ADDIE development approach, encompassing the sequential phases of analysis, design, development, implementation, and evaluation. The validation results obtained from the five validators indicate that the RME-based learning aids that have been developed have a high level of validity in the context of LKS. The evaluation of LKS's appropriateness by users, specifically instructors, yielded an average score of 4.4, indicating that it falls within the highly viable range. In addition, the LKS evaluation results of the pupils yielded an average score of 4.89, indicating a very feasible.

Based on the aforementioned findings, it can be inferred that the learning tools that have been developed exhibit efficacy in facilitating mathematics education, specifically in the context of comparable fractions. These tools have demonstrated the ability to successfully attain comprehensive student learning objectives, enhance student engagement during the learning process, and elicit favorable student reactions towards the learning experience. The learning tools that have been developed can also be applied to the teaching of comparable fractions in mathematics. These tools have the capacity to facilitate the attainment of comprehensive learning outcomes for students, enhance student engagement and participation, and elicit favorable reactions towards the utilization of worksheets.

The development of this learning tool based on RME (Realistic Mathematics Education) for equivalent fractions is subject to certain limitations. The trial was conducted only on a sample of 14 fourth-grade pupils at SD Alam Surakarta. Additional testing is required with a larger sample size of pupils in order to assess the applicability of the material presented in this educational tool, specifically focusing on fractions equivalent to the curriculum typically covered in fourth grade elementary school. For further research, it is recommended to conduct research and development of mathematics learning tools that are tested on a wider scale and can develop other learning tools such as modules, IT-based learning media, and so on based on PMR and HOTS-oriented on other materials.

Then the effectiveness of RME-based learning tools in the form of LKS according to research conducted by Sutarni and Aryuana (2023) said that the Realistic Mathematics Education (RME) learning model can improve the problem-solving ability of HOTS-oriented mathematics students, including being able to make students more focused and enthusiastic in the learning process, more actively receiving material, and more interesting communication between researchers and students. In accordance with the results of the analysis of students' scores before and after the action in this study obtained, the average mathematics score before and after the action with HOTS-oriented realistic mathematics learning was 80.35. This indicates that there is an increase in the average mathematics learning outcomes in students by 5.28 so that it can be said that there is an increase in HOTS ability in students before and after action with RME-based learning tools in the form of HOTS-oriented LKS.

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