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Ethnomathematics Food Traditional Kicimpring: Designing and Validation Worksheets to Deepen Understanding of Direct Proportion Concepts

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Abstract: Students experienced difficulties in understanding the basic concept of Direct Proportion and relating this concept to everyday contexts. This study aims to develop ethnomathematics-based worksheets using the traditional Sundanese food kicimpring to improve junior high school students' understanding of Direct Proportion in a valid manner. This study used the research and development method with a 4D model that included define, design, develop, and disseminate. The research instruments used were validation sheets by lecturers and mathematics teachers as well as practicality questionnaires by students. The results of the study showed an average validation of 96.4% (highly valid). This shows that an ethnomathematics-based worksheet using traditional Sundanese food kicimpring, to improve the understanding of the concept of Direct Proportion in junior high school students is valid and feasible to continue further research on its effectiveness.

Keywords: Ethnomathematics, Direct Proportion, Kicimpring, Worksheets

Introduction

Mathematics is a fundamental science that plays an important role in life and is needed in every discipline (Sinaga, 2023). Given its importance, mathematics is a compulsory subject from elementary to higher education levels (Astika Desanti et al., 2023). However, many students at various school levels find mathematics boring, unappealing, and uninteresting (Putri, 2023). According to Nu'man & Azka (2023) and Fathurohman (2023), this is triggered by various difficulties faced by students, including difficulties in solving mathematical problems, inability to identify problem structures, and focusing on calculations and memorizing formulas without understanding the concepts. This condition is reinforced by the 2018 Programme for International Student Assessment (PISA) report, in which Indonesia ranked 72nd out of 78 countries in mathematics (Putrawangsa & Hasanah, 2022). This figure clearly indicates that learning outcomes in mathematics in Indonesia are still

very low. These difficulties become even more acute when entering materials that require deep conceptual understanding and proportional reasoning, such as in proportion materials (Mustika, 2024).

The basic concept of proportion is often a hurdle because it requires students to understand the relationship between quantities abstractly and be able to distinguish and apply the right strategies for Direct Proportions in real-life contexts (Anjelina & Ismail, 2023). According to research (Tito et al., 2025; Sugiarni, et al., 2022), difficulties in Direct Proportion material are caused by a lack of in-depth understanding of basic concepts, application of formulas, and students' low ability to identify problems in relevant contexts. Therefore, a more interactive and contextual teaching approach and the development of innovative teaching materials are needed.

In this context, innovation in teaching is an urgent need. Exploration and utilization of various learning media and teaching materials can be strategies to improve students' understanding of abstract Direct Proportion concepts and make them more concrete (Siregar et al., 2024). One strategy that has the potential to increase student engagement in the process of understanding the concept of equivalent ratios is through the development of student worksheets with more contextual material. Although many worksheets cover material on equivalent ratios, most of them are still conventional and do not integrate elements of local culture.

Culture has great potential to be used as a relevant and interesting learning context, because culture is knowledge or various customs that develop in society (Wardani et al., 2023). The integration of cultural elements into mathematics learning is often known as ethnomathematics. Ethnomathematics was first introduced by D'Ambrosio (1985), who defined it as the anthropological study of mathematical thinking and practices that develop within a culture in society (Ekwandani et al., 2022). In the context of learning, ethnomathematics is related to Realistic Mathematics Education (RME), as both emphasize the use of real-life situations as a starting point for mathematics learning, but ethnomathematics specifically places local culture as the main source of context. Thus, ethnomathematics becomes a bridge that connects formal mathematical concepts with mathematical practices that exist in local cultures, and allows students to see the relevance of mathematical concepts in their daily lives. Linking the concept of equivalent ratios with cultural elements inherent in students' lives not only makes learning more contextual, but also more meaningful because it reintroduces the culture that surrounds them. One local culture that can be utilized in mathematics learning is traditional kicimpring food, which naturally contains the concept of Direct Proportion, for example, between the amount of raw materials and the production output.

Kicimpring is a type of cracker originating from the Sundanese region, made from cassava mixed with spices and fried (Mubarok, 2022). The name “kicimpring” comes from the Sundanese word “cimpring,” which means thin, referring to the texture of kicimpring. Through this traditional food, we can explore mathematical concepts such as sets, geometry, social arithmetic, algebraic modeling, and proportions. In this context, the traditional food kicimpring has the potential to be used as a medium for teaching the concept of equivalent ratios conceptually. The development of ethnomathematics-based worksheets based on the traditional food kicimpring is expected to deepen students' understanding of the concept, their interest in learning, and their appreciation of culture through a local cultural approach.

However, to date, there has been no research that specifically explores the relationship between the traditional food kicimpring and the concept of equivalent ratios. Therefore, this study aims to develop ethnomathematics-based worksheets using the traditional food kicimpring to improve junior high school students' understanding of the concept of equivalent ratios.

Method

The research method used was the research and development method. The research instruments used were validation sheets and practicality questionnaires involving 1 lecturer, 1 mathematics teacher, and 4 students. The product developed in this study was an Ethnomathematics-based student worksheet using food traditional Kicimpring to improve understanding of the concept of equivalent ratios using the 4D development model. This model consists of 4 stages, namely Define, Design, Develop, and Disseminate (Sugiyono (2016), in Muqdamien et al., 2021). This research was conducted from November 28, 2024, to January 8, 2025. The stages of this research are shown in Figure 1 below.

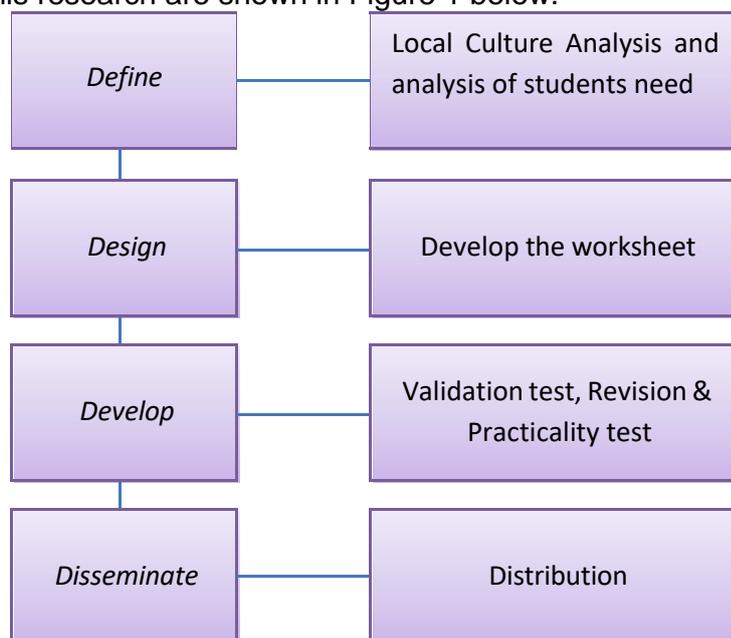


Figure 1. 4D model development procedure

This study is limited to only three stages of the overall process, namely Define, Design, and Develop. These three stages are carried out sequentially and systematically, as follows:

Define Stage

The definition stage includes analysis of local culture, student needs, and formulation of learning objectives. Analysis of local culture is carried out by examining values, customs, and local wisdom relevant to learning. Analysis of student needs includes identification of characteristics, interests, and learning difficulties through literature review. The results of these two analyses are used to formulate learning objectives tailored to mathematics learning outcomes.

Design Stage

At this stage, learning models are selected and ethnomathematics activities are designed based on the results of the definition stage. This stage aims to design contextual learning that integrates local cultural values into learning activities.

Development Stage

At this stage, ethnomathematics-based student worksheets were developed using the traditional food Kicimpring as a learning resource to improve junior high school students' understanding of the concept of equivalent ratios. This development was based on the assessment results of two validators. Validation was carried out to assess the validity of the student worksheets, with reference to the suggestions, comments, and assessments provided. The validation data processing process included: 1) data collection from one lecturer from the Mathematics Education Study Program in Cianjur and one mathematics teacher, 2) calculation of validation scores, and 3) processing of final scores according to assessment criteria.

The analysis of the worksheet validation test results by validators was obtained from the validation sheet, using the following formula:

$$NP_{r_n} = \frac{TS_{-e}}{TS_{-max}} \times 100\%$$

After obtaining the validation results from each validator, a combined validation calculation is then performed by analyzing the data using the following formula:

$$V = \frac{NP_{r_1} + NP_{r_2}}{2} = \dots\%$$

Keterangan:

V = combined validation

NP_{r_1} = first validator process value

NP_{r_2} = second validator process value

TS_{-e} = total empirical score (score obtained from the validators)

TS_{-max} = maximum expected score

The results of validation calculations can be seen in the categories in Table 1.

Table 1. Categorization of Validity Using an Ethnomathematics Approach

Validity Criteria	Level of Validity
80,01% - 100%	highly valid, used without revision
60,01% - 80,00%	Valid, useble but needs minor revision
40,01% - 60,00%	Less valid, not recommended for use as major revisions are required
20,01% - 40,00%	Invalid, must not be used
00,00% - 20,00%	Highly invalid, must not be used

(Arikunto in Datu *et al.*, 2024)

After developing ethnomathematics-based worksheets through food traditional Kicimpring, an analysis of the practicality of worksheets was conducted to determine the students' response to the practicality of the teaching materials.

The analysis of the results of the practicality test of worksheets by students was obtained from a questionnaire sheet, using the following formula:

$$P = \frac{\sum F}{(N \times I \times R)} \times 100\%$$

Keterangan:

P = percentage

$\sum F$ = total score of all respondents

N = number of respondents

I = maximum score

R = number of indicators

The results of the questionnaire calculations can be seen in the categories in Table 2.

Table 2. Categorization of Worksheet Practicality Using an Ethnomathematics Approach

Practicality Criteria	Level of Practicality
80,01% - 100%	Very practical
60,01% - 80,00%	Practical
40,01% - 60,00%	Less practical
20,01% - 40,00%	Impractical

00,00% - 20,00% Very impractical

(Arikunto in Datu *et al.*, 2024)

Results and Discussion

The result of this study is an Ethnomathematics-based worksheets using food traditional Kicimpring to Improve Junior High School Students' Understanding of Equivalent Ratios, which is ready to be validated in terms of design, quality, appearance, language, and content. The description of the development stages carried out by the researcher is as follows:

Define Stage

Local Culture Analysis

Literature studies show that there has been no development of student worksheets that integrate the traditional food kicimpring with the concept of Direct Proportions in mathematics. The implementation of ethnomathematics through traditional foods is in line with the research by Ningrum & Wiryanto (2022), which uses the context of traditional foods for mathematics learning. Therefore, the researchers designed ethnomathematics-based worksheet through food traditional kicimpring to increase student engagement and facilitate understanding of concepts through familiar local cultural contexts. In line with the research by Serepinah et al. (2023), the integration of local culture (ethnomathematics) in learning has the potential to increase learning motivation, student engagement, deeper understanding of mathematical concepts, and appreciation of cultural diversity.

Analysis of Student Needs

An analysis of needs based on the literature reveals that junior high school students often have difficulty understanding basic concepts and abstract relationships of Direct Proportions, especially in applying problem-solving strategies in real-life contexts, in line with research (Agnesti & Amelia, 2021). This indicates the need for a contextual approach that involves local culture, in line with Kumala, (2022) recommendation to use the context of local culture to make the concept of equivalent ratios more meaningful.

Formulation of Learning Objectives

The learning objectives are designed to be achieved in two lessons (2 Lessons), namely: 1) Students can identify issues related to the cultural context, namely the production of food traditional kicimpring, 2) Discover the concept of

Direct Proportion from the cultural context, namely food traditional kicimpring, and
3) Solve Direct Proportion problems accurately.

Design Stage

Selection of Learning Model

In the design stage, the Problem-Based Learning (PBL) model was selected as the basis for developing the worksheet. This model encourages active involvement of students in discovering the concept of equivalent ratios through exploration and reasoning on contextual problems based on cultural contexts, namely traditional kicimpring food, so that students can build knowledge independently, rather than just passively receiving information. This is in line with the research by Mangaraja et al. (2025), which shows that the application of the PBL model significantly improves conceptual understanding, and Syahfitri & Fauzan (2025), which shows that the application of the PBL model improves students' mathematical problem-solving skills. Furthermore, combining PBL with cultural context (ethnomathematics) can improve student learning outcomes (Fatmawati et al., 2024).

Designing Ethnomathematics Activities

The design of ethnomathematics activities began with introducing the traditional food kicimpring in the worksheets and the process of making kicimpring through educational videos. Students are divided into several groups to explore problems in the kicimpring production process. Through this exploration, students discuss to discover the concept of equivalent ratios. After understanding the concept of equivalent ratios, students are asked to apply this concept in solving contextual problems related to the context of food traditional kicimpring.

Develop Stage

Expert Validation

Ethnomathematics-based worksheet through food traditional Kicimpring was validated by a validation team consisting of lecturers and mathematics teachers. This validation aimed to assess the feasibility of worksheet based on aspects of content suitability, systematic arrangement, and integration with learning objectives. The assessment was conducted using a validation sheet covering 11 assessment aspects. Of the 11 assessment aspects, several aspects received the lowest scores, including the aspect of cultural context suitability with the mathematical content in the worksheet, the clear structure of the worksheet requiring literacy and

numeracy skills, the correctness of grammar and spelling in the worksheet, and the attractive and consistent visual appearance of the worksheet.

In terms of the cultural context's suitability to the mathematical content in the worksheet, it indicates that the use of the food traditional kicimpring is still superficial or has not touched on strong mathematical substance, such as the process of making kicimpring, which has rich geometry and patterns (e.g., shape, thickness, and arrangement pattern when drying). In terms of the structure of the worksheet, which is unclear and requires literacy and numeracy skills, a high-quality worksheet does not only contain a large number of questions, but must also stimulate the literacy and numeracy skills of students in understanding and managing information from texts about the food traditional kicimpring and using mathematical concepts in a cultural context. In terms of grammar and spelling in the worksheet, the text about the traditional food kicimpring is still quite long and there are several sentences that are too convoluted, and there are several misspelled words. Then, in terms of the visual appearance of the worksheet, which is unattractive and inconsistent, this aspect is not just a matter of aesthetics, but a crucial element that can engage students' interest in learning. If the worksheet has attractive and consistent visuals, it can be crucial in determining student engagement in a more effective learning process. The assessment results show the validity level of the LKPD in terms of presentation, as presented in Table 3 below.

Table 3. The Worksheet Validation Results for each Validator in Terms of Presentation Feasibility Using the Guttman Scale

Validator	Empirical Score	Maximum Score	Average validity percentage of each validator	Validity Criteria
Validator 1	52	55	94,6%	Highly Valid
Validator 2	54	55	98,2%	Highly Valid
Combined Average Percentage			96,4%	Highly Valid

Based on Table 3, the average percentage of validation of the feasibility aspect reached 96,4% with the category "highly valid". This shows that the worksheet has been compiled systematically, clearly, and in accordance with the learning objectives. Therefore, the worksheet is declared feasible for use with minor revisions.

Initial Product Revision

As a follow-up to the validation, input from both validators formed the basis for improving the quality of the worksheet. The suggestions and improvements proposed are presented in Table 4 below.

Table 4. Suggestions and Improvements The Worksheet

Figure		Suggestions and Improvements
Before Revision	After Revision	
		<p>In the section on writing important words, it is emphasized how many, but the important words in the worksheet regarding kicimpring do not refer to comparative material, because students can fill in things that are not related to the material to be studied.</p>
		<p>In "Let's find a concept," provide context related to the traditional food kicimpring, then add "let's help UMKM owners" to solve problems as an application of the concept that has been obtained. Only one table needs to be filled in and add a picture.</p>

Figure		Suggestions and Improvements															
Before Revision	After Revision																
<p>AYO TEMUKAN KONSEP</p> <p>Coba amat dan amatlah data tabel dan grafik yang disajikan. Dan tabel dan grafik tersebut digunakan untuk perbandingan.</p> <p>Coba buatlah kesimpulan hubungan antara banyaknya bahan pokok yang digunakan dengan banyaknya hasil produksi!</p> <p>Berdasarkan hubungan pada grafik, jika A dan B adalah bahan pokok yang digunakan maka C dan D adalah hasil produksi. Berapa C dan D jika A dan B adalah bahan pokok yang digunakan.</p> <p>Berapa D dan B jika A dan C adalah bahan pokok yang digunakan.</p>	<p>Coba amat dan amatlah data tabel dan grafik!</p> <p>Dari data tersebut diperoleh nilai perbandingan:</p> <p>Berdasarkan grafik, membuat a, dan b, adalah banyak adonan yang dibutuhkan untuk a, dan b, adalah banyak adonan yang dibutuhkan, maka:</p> <p>... senilai dengan ... atau ...</p> <p>Dan apabila dikali dengan maka:</p> <p>... senilai dengan ... atau ...</p> <p>Berapa diperoleh nilai perbandingan maka:</p> <p>... atau ...</p>	<p>The dots are too small</p>															
<p>AYO BERNALAR</p> <p>Ibu A adalah pemilik sebuah rumah produksi kue kering. Pada hari Sabtu, ia akan memproduksi kue kering dengan bahan pokok sebanyak 20 kg. Hasil dari produksi itu akan digunakan untuk 10 kue. Untuk kegiatan kue kering tersebut akan di jual sebanyak 10 kue. Ibu A akan menjual kue tersebut dengan harga Rp 50.000,00. Ibu A akan menjual kue tersebut dengan harga Rp 50.000,00. Ibu A akan menjual kue tersebut dengan harga Rp 50.000,00.</p> <table border="1"> <thead> <tr> <th>Bahan pokok</th> <th>Banyaknya kue</th> <th>Harga</th> </tr> </thead> <tbody> <tr> <td>20 kg</td> <td>10 kue</td> <td>50.000</td> </tr> <tr> <td>...</td> <td>...</td> <td>...</td> </tr> </tbody> </table>	Bahan pokok	Banyaknya kue	Harga	20 kg	10 kue	50.000	<p>AYO BERNALAR</p> <p>Ibu A adalah pemilik sebuah rumah produksi kue kering. Pada hari Sabtu, ia akan memproduksi kue kering dengan bahan pokok sebanyak 20 kg. Pada hari itu, hasil produksi itu akan digunakan untuk 10 kue. Ibu A akan menjual kue tersebut dengan harga Rp 50.000,00. Ibu A akan menjual kue tersebut dengan harga Rp 50.000,00. Ibu A akan menjual kue tersebut dengan harga Rp 50.000,00.</p> <table border="1"> <thead> <tr> <th>Bahan pokok (kg)</th> <th>Banyaknya kue</th> </tr> </thead> <tbody> <tr> <td>20</td> <td>10</td> </tr> <tr> <td>...</td> <td>...</td> </tr> </tbody> </table> <p>Berdasarkan data tersebut, Ibu A akan menentukan harga adonan yang harus dibayar. Ibu A akan menentukan harga adonan yang harus dibayar. Ibu A akan menentukan harga adonan yang harus dibayar.</p> <p>BENAR atau SALAH</p>	Bahan pokok (kg)	Banyaknya kue	20	10	<p>Add true or false after the table to practice basic reasoning about Direct Proportions.</p>
Bahan pokok	Banyaknya kue	Harga															
20 kg	10 kue	50.000															
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Bahan pokok (kg)	Banyaknya kue																
20	10																
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<p>AYO BERLATIH</p> <p>Ibu A akan memproduksi kue kering dengan bahan pokok sebanyak 100 kg. Berapa banyak kue kering yang dihasilkan dari proses produksi tersebut. Berapa banyak kue kering yang dihasilkan dari proses produksi tersebut.</p>	<p>AYO BERLATIH</p> <p>Ibu A akan memproduksi kue kering dengan bahan pokok sebanyak 100 kg. Berapa banyak kue kering yang dihasilkan dari proses produksi tersebut. Berapa banyak kue kering yang dihasilkan dari proses produksi tersebut.</p>	<p>The dots for answer no need for too much.</p>															
<p>AYO MEMBUAT SIMPULAN</p> <p>Berapa banyak kue kering yang dihasilkan dari proses produksi tersebut. Berapa banyak kue kering yang dihasilkan dari proses produksi tersebut.</p>	<p>AYO SIMPULKAN</p> <p>Berapa banyak kue kering yang dihasilkan dari proses produksi tersebut. Berapa banyak kue kering yang dihasilkan dari proses produksi tersebut.</p>																

Based on the results of expert assessment, the development process of ethnomathematics-based worksheet on food traditional kicimpring focused on the assessment results in areas that needed improvement, suggestions and corrections that needed to be made so that the development of worksheet could be maximized. In response to the input on strengthening the ethnomathematics substance by creating a clearer and more concise narrative about the food traditional kicimpring, providing learning video links to introduce the culture, and adding pictures of the food. Then, in optimizing literacy and numeracy aspects, the worksheet structure was rearranged by reducing the load of repetitive questions and replacing them with the learning model flow used. The new structure was designed to stimulate students' ability to manage information from the narrative text of traditional kicimpring food, discover the concept of Direct Proportion, and use this concept. Furthermore, in terms of language, a comprehensive review was conducted to simplify overly convoluted sentences to make them more communicative, and PUEBI improvements were carried out meticulously, ensuring the use of simpler sentences to avoid ambiguity when students understand the material. Furthermore, to increase student engagement, the visual aesthetics were updated by applying a consistent but not excessive design and using harmonious colors and more realistic photos. The following are the results of the worksheet development up to the validation and revision stage by experts, and the results of the worksheet development are presented in Figure 2.

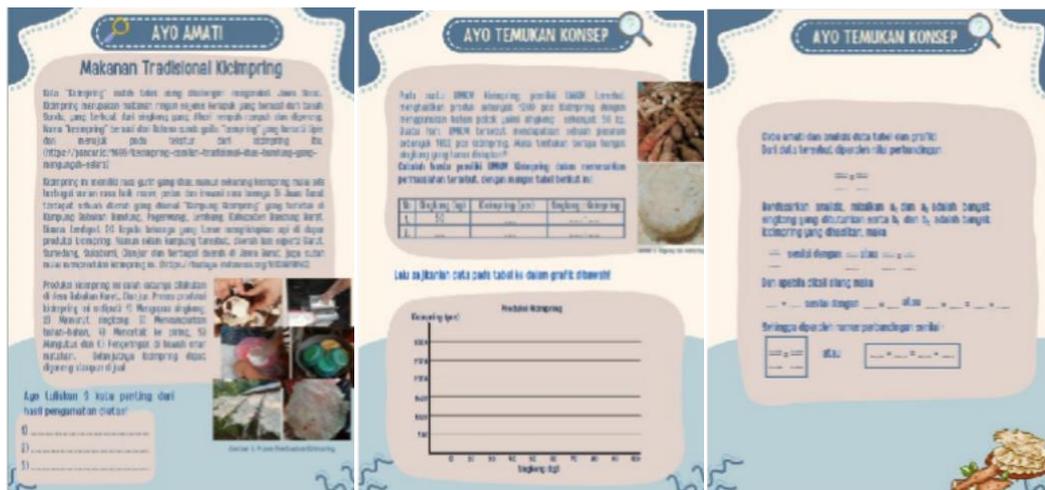




Figure 2. Results of the Development and Validation of Ethnomathematics-based worksheet through Food Traditional Kicimpring to Improve Understanding of Direct Proportion Concept

After going through the validation and revision stages, the worksheet that has been developed shows “highly valid” criteria, so that a practicality test can be carried out

Practicality Test

This practicality test was conducted to measure the ease of use, level of understanding, and attractiveness of the worksheet to students’ interest in learning worksheet that had been developed. This practicality test was conducted on four 9 grade junior high school students, and the result are presented in Table 5.

Tabel 5. Practicality Data of Worksheet

No.	Responden	Total Score
1.	S1	39
2.	S2	40
3.	S3	39
4.	S4	36
Total Combined Score		154
Total Maximum Score		160
Average (%)		96,25 %
Practicality Criteria		Very Pratical

Based on Table 5, the results of the worksheet practicality questionnaire on the aspect of practicality of presentation obtained a combined average percentage of 96.25% from the four students, with a criterion of “Very Practical.” This proves

that the worksheet developed is very practical for use as a medium for mathematics learning.

Conclusion

Based on the research results, the development of the worksheet was carried out up to the validation stage, with the validation results using the Guttman scale stating that the worksheet developed was highly valid with an average percentage of 96.4%. This score indicates that the worksheet was systematically compiled and in accordance with the ethnomathematics approach. In terms of practicality, the student questionnaire showed an average score of 96.25% in the "Very Practical" category. Students rated the worksheet as easy to use, clear, and relevant to the local cultural context. This response indicates that the worksheet is effective in helping students understand mathematical concepts. Thus, the worksheet is suitable for use in learning with minor revisions according to the validator's input for further improvement.

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