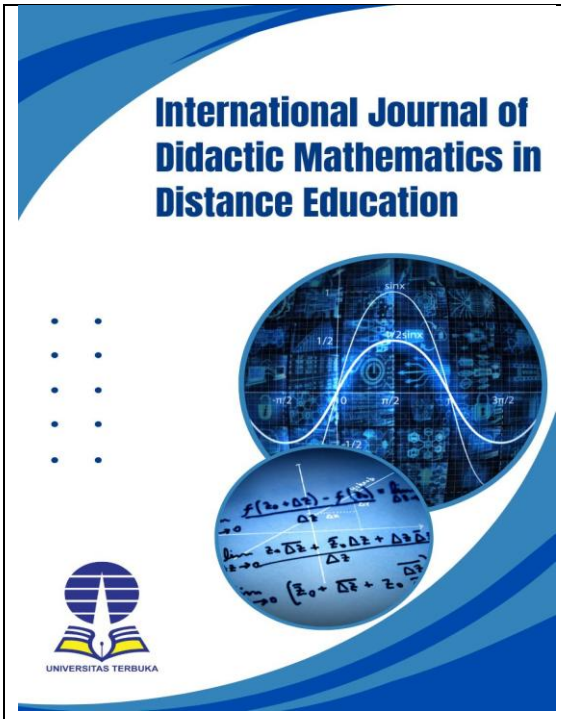
INTERNATIONAL JOURNAL OF
DIDACTIC MATHEMATICS IN DISTANCE EDUCATION

**Journal homepage:** https://jurnal.ut.ac.id/index.php/ijdmde




# Integrating Pandanwangi ethnomathematics into E-worksheets to support numeracy in online mathematics learning

**Rani Sugiarni [1], Hutkemri Zulnaidi[2], Dinni Nurfajrin Ningsih[3], Reza Rahman Hakim[4], Erwan Setiawan[5]**

[1]Departements of Mathematics Education, Universitas Suryakancana, Cianjur, West Java, Indonesia, ranisugiarni@gmail.com

[2]Department of Mathematics and Science Education, Faculty of Education, University of Malaya hutkemri@um.edu.my

[3]Departments of Mathematics Education, Universitas Suryakancana, Cianjur, West Java, Indonesia, nurfajrinningsih@gmail.com

[4]Departments of Mathematics Education, Universitas Suryakancana, Cianjur, West Java, Indonesia, nurfajrinningsih@gmail.com

[5]Departments of Mathematics Education, Universitas Suryakancana, Cianjur, West Java, Indonesia, erwan@unsur.ac.id

**To cite this article**:
Sugiarni, R., Zulnaidi, H., Ningsih, D.F., Hakim, R.R., & Erwan Setiawan, E. (2026). Integrating Pandanwangi ethnomathematics into E-worksheets to support numeracy in online mathematics learning. *International Journal of Didactic Mathematics in Distance Education*, *3*(2), 184-209.

**To link to this article**:
https://jurnal.ut.ac.id/index.php/ijdmde

**Published by:**
Universitas Terbuka
Jl. Pd. Cabe Raya, Pd. Cabe Udik, Kec. Pamulang, Kota Tangerang Selatan, Banten 15437

International Journal of Didactic Mathematics in Distance Education
https://jurnal.ut.ac.id/index.php/ijdmde

# Integrating Pandanwangi ethnomathematics into E-worksheets to support numeracy in online mathematics learning

**Rani Sugiarni [1*], Hutkemri Zulnaidi[2], Dinni Nurfajrin Ningsih[3], Reza Rahman Hakim[4], Erwan Setiawan[5]**

[1]Departments of Mathematics Education, Universitas Suryakancana, Cianjur, West Java, Indonesia, ranisugiarni@gmail.com

[2]Department of Mathematics and Science Education, Faculty of Education, University of Malaya hutkemri@um.edu.my

[3]Departments of Mathematics Education, Universitas Suryakancana, Cianjur, West Java, Indonesia, nurfajrinningsih@gmail.com

[4]Departments of Mathematics Education, Universitas Suryakancana, Cianjur, West Java, Indonesia, nurfajrinningsih@gmail.com

[5]Departments of Mathematics Education, Universitas Suryakancana, Cianjur, West Java, Indonesia, erwan@unsur.ac.id

*Correspondence: ranisugiarni@gmail.com

**Abstract**

Online mathematics learning requires digital resources that are not only accessible but also capable of connecting abstract mathematical concepts with meaningful real-life contexts. However, culturally contextualized digital materials for supporting numeracy remain limited, particularly for proportion concepts that students often find difficult to understand. This study developed an ethnomathematics-based e-worksheet integrating the agricultural practices of Pandanwangi rice farmers in Cianjur as a contextual digital resource to support numeracy in online mathematics learning. Using a research and development approach, the study followed three stages of the Plomp model: preliminary investigation, prototyping, and assessment. Product evaluation involved two lecturers, one mathematics teacher, and ten seventh-grade students. Data were collected through expert validation sheets and practicality questionnaires and analyzed descriptively. The results showed that the e-worksheet was highly valid, with media design ratings ranging from 92% to 95% and learning material ratings from 92% to 93%. It was also highly practical according to the teacher (95%), while students reported a practicality rating of 76%, indicating acceptable usability from the learner perspective. By transforming Pandanwangi farming practices into digital, contextual proportion activities, the e-worksheet connects local ethnomathematical knowledge with numeracy-oriented tasks that can be accessed through online learning environments. These findings establish its validity and practicality as a culturally contextualized digital resource for supporting numeracy in online mathematics learning.

**Article History**

Received:
January 26, 2026
Revised:
March 31, 2026
Accepted:
April 10, 2026
Published Online:
August 31, 2026

**Keywords:**

E-worksheet;
Ethnomathematics;
Numeracy;
Online mathematics learning;
Pandanwangi

## 1. Introduction

Numeracy is fundamentally concerned with the use of mathematics beyond formal mathematical exercises. The concept, initially articulated in the Crowther Report and subsequently elaborated by Cockcroft (1982), encompasses the ability to use mathematical knowledge in everyday life and to interpret information represented through numbers, tables, graphs, and other mathematical forms. Contemporary definitions further emphasize this contextual orientation. PISA conceptualizes mathematical literacy as the capacity to reason mathematically and to formulate, employ, and interpret mathematics in real-world situations (Kolar & Hodnik, 2021). Similarly, numeracy has been described as the capacity to process, communicate, and interpret numerical information in different situations (Muir, 2008). Thus, numeracy cannot be reduced to computational competence; it involves recognizing when mathematics is relevant, translating contextual situations into mathematical representations, using appropriate procedures, and interpreting mathematical results in relation to the original situation.

This conception has important pedagogical implications. If numeracy concerns the movement between mathematics and real-world situations, its development requires learning experiences in which mathematical concepts are encountered within contexts that students can interpret and reason about. Students need opportunities not only to calculate but also to identify quantitative relationships, determine relevant information, choose mathematical representations, and judge whether their solutions make sense within a particular situation (Aziz et al., 2021; Segers et al., 2015). This orientation is consistent with the Indonesian conception of numeracy, which emphasizes applying mathematical concepts and procedures to everyday problems situated within personally, socially, and globally relevant contexts (Taufiqoh et al., 2023). Consequently, the quality of the context through which mathematics is learned becomes central to numeracy development.

This issue remains particularly important in Indonesia. PISA results indicate that Indonesian students have not demonstrated consistent improvement in mathematical literacy across recent assessment cycles, including 2015, 2018, and 2022 (Muhaimin et al., 2024; Wijaya et al., 2022). At the national level, numeracy has also become a central component of the *Asesmen Kompetensi Minimum* (AKM), while previous research continues to identify difficulties among secondary school students in solving numeracy-oriented problems (Sugiarni et al., 2023; Syaifuddin, 2022). These difficulties cannot be attributed solely to students' computational knowledge. Limited exposure to learning materials that require students to use mathematics meaningfully in contextual situations has also been identified as an important concern (Fointuna, 2021). Strengthening numeracy therefore requires a shift from mathematics materials dominated by procedural exercises toward resources that repeatedly engage students in interpreting and mathematizing situations connected with everyday experience.

The need for such contextualization becomes more complex when mathematics learning moves into online environments. Online learning can extend access to

mathematical resources beyond the physical classroom and provide flexibility in time, place, and learning pace. However, digital access does not necessarily produce contextual access to mathematics. When conventional exercises are merely transferred from paper to screens, students may interact with mathematics digitally while still experiencing it as abstract, symbolic, and detached from situations in which mathematical reasoning has meaning. This pattern has been documented in other numeracy-related domains delivered online: Isnawan and Alsulami (2024) found that an online didactical design for ordering fractions still required explicit attention to students' unresolved prerequisite understanding of least common multiples before core learning could proceed, showing that digitizing a mathematical task does not by itself resolve the conceptual obstacles beneath it. This creates an important pedagogical tension for online mathematics learning: the learning environment becomes less dependent on physical proximity, yet numeracy requires students to connect mathematics closely with the social and practical environments in which quantitative reasoning occurs. Therefore, designing resources for online mathematics learning involves more than digitizing mathematical content; it requires designing digital experiences that preserve or reconstruct connections between formal mathematics and students' lived worlds.

From this perspective, an e-worksheet can be understood not simply as an electronic replacement for a printed worksheet, but as a pedagogical interface between the learner, mathematical content, and real-world context in a digitally mediated environment. Worksheets already provide structured sequences of activities and instructions through which students engage actively with learning tasks (Lestari et al., 2021; Kurniasi et al., 2022). Their electronic form extends this function by enabling tasks to be accessed, completed, and submitted across different locations and times. Interactive e-worksheet environments can also provide representations, prompts, structured questions, and spaces for responses within a single digital resource. These characteristics are particularly relevant to online mathematics learning, where students may need stronger task structures to guide their mathematical activity when immediate face-to-face teacher mediation is limited.

Previous research demonstrates that e-worksheets can support interactive learning activities (Yanto et al., 2024), are generally acceptable to teachers and students in e-learning contexts (Sugiarni et al., 2019), and can achieve satisfactory levels of validity and feasibility (Namisango et al., 2022). Platforms such as Liveworksheets additionally allow students to complete tasks and communicate responses electronically, potentially supporting independence, confidence, curiosity, and engagement (Pakabu et al., 2024). E-worksheets have also been associated with mathematical learning outcomes, abstraction skills, and conceptual understanding (Prabowo, 2021). Nevertheless, these technological affordances address only one dimension of online mathematics learning. An e-worksheet may be digitally interactive yet mathematically decontextualized. For numeracy, this distinction is critical because interactivity concerns how students engage with a digital resource, whereas contextuality concerns how they connect mathematical ideas with situations beyond the resource itself.

Accordingly, the central design question is not simply how to make a worksheet electronic, but how an electronic worksheet can reconnect online mathematical activity with students' experiential and cultural worlds. Ethnomathematics provides a conceptual basis for addressing this question. Ethnomathematics recognizes that mathematical ideas and reasoning are embedded within cultural practices and everyday activities rather than existing exclusively in formal school mathematics. From this perspective, activities such as measuring, estimating, comparing, counting, organizing, and determining quantities within a community can constitute meaningful sources for mathematical learning. Connecting these practices with formal mathematical concepts can make school mathematics more relevant and meaningful (Rosa & Orey, 2013) and may contribute to students' motivation and confidence (Amit & Abu Qouder, 2017). Indonesia, with its diverse cultural and occupational practices, provides particularly rich possibilities for transforming locally situated mathematical knowledge into educational resources (Bantaika et al., 2025; Husna et al., 2021a).

The relationship between ethnomathematics and online learning is therefore more substantial than simply presenting cultural images or stories in digital form. Ethnomathematics can function as a contextualizing mechanism within the digital environment. While online learning creates spatial separation between learners, teachers, and conventional classroom resources, ethnomathematical tasks can bring students' surrounding practices into that learning space. In this sense, the e-worksheet serves as a digital bridge between two mathematical spaces: mathematics as practiced within local everyday activities and mathematics as formally represented in school. Students can begin with a recognizable activity, identify the quantitative relationships embedded within it, represent those relationships mathematically, perform the required reasoning, and then interpret the resulting mathematics back within the original context. Such movement between context and formal representation corresponds closely to the processes required in numeracy.

This relationship is especially relevant when students learn proportion. Proportion is often introduced through formal expressions, ratios, and algorithms, although proportional reasoning is widely embedded in everyday activities involving comparisons between quantities, scaling, measurement, production, and resource allocation. If these relationships are presented only symbolically in an online environment, students may learn procedures without understanding what the relationships represent. Contextualizing proportion through authentic activities therefore provides an opportunity to shift online mathematical tasks from merely calculating ratios toward interpreting relationships between quantities. An ethnomathematics-based e-worksheet can structure this progression by first presenting culturally situated quantitative situations, guiding students to identify relevant quantities and relationships, translating them into proportional representations, and finally asking students to interpret their mathematical results within the original context. The digital worksheet consequently becomes a space for mathematization rather than merely a screen for exercises.

The activities of Pandanwangi rice farmers in Cianjur provide a relevant context for this purpose. Agricultural practices involve relationships among quantities, measurements, comparisons, and other forms of quantitative reasoning that can be reconstructed as proportion-related mathematical situations. More importantly, these practices represent locally situated knowledge rather than artificial word-problem contexts created solely for classroom exercises. Incorporating such practices into an e-worksheet therefore allows students to encounter formal proportion concepts through quantitative relationships derived from an authentic cultural and occupational environment. Within online mathematics learning, this integration enables a local physical practice to be represented and explored within a digital learning space, thereby connecting place-based mathematical knowledge with place-independent access to learning.

Previous studies have demonstrated the potential of ethnomathematics-based worksheets using cultural contexts such as *Tembe Nggoli* woven fabric (Sowanto & Mulyadin, 2019), traditional *Engklek* games (Sholihah et al., 2022), *Rumah Gadang* (Setiawan et al., 2021), Sundanese Pupuh for number pattern learning (Aulia et al., 2025), and other contextual resources for mathematics learning (Zuhra et al., 2021; Vitoria & Monawati, 2020). Ethnomathematics-oriented worksheets have also been associated with conceptual understanding (Marlina & Azis, 2023) and dimensions of creative thinking (Arion, 2024). These studies establish the educational value of incorporating cultural contexts into worksheets. However, they leave a more specific issue insufficiently addressed: how locally situated mathematical practices can be pedagogically reconstructed within an electronic worksheet to support numeracy when mathematics learning occurs through an online environment. Existing work has largely treated ethnomathematics, worksheets, digital media, and numeracy as related but relatively separate concerns.

The present study addresses this intersection. Its novelty does not rest merely on being the first e-worksheet to feature Pandanwangi farmers. Rather, it lies in the pedagogical transformation of Pandanwangi farming practices from situated cultural activities into digitally accessible numeracy tasks for online mathematics learning. The proposed e-worksheet is designed to connect three spaces that are often separated: students' lived and cultural environment, formal proportion concepts, and the digital environment in which mathematical learning occurs. Pandanwangi ethnomathematics supplies authentic quantitative situations; numeracy provides the mathematical processes through which those situations are interpreted and mathematized; and the e-worksheet provides the digital structure through which these experiences can be accessed and organized in online learning. Accordingly, this study aims to design and evaluate an e-worksheet integrating Pandanwangi ethnomathematics to support numeracy in online mathematics learning. As an initial developmental study, the assessment focuses on establishing the validity and practicality of the proposed integration rather than determining its effectiveness in improving students' numeracy outcomes.

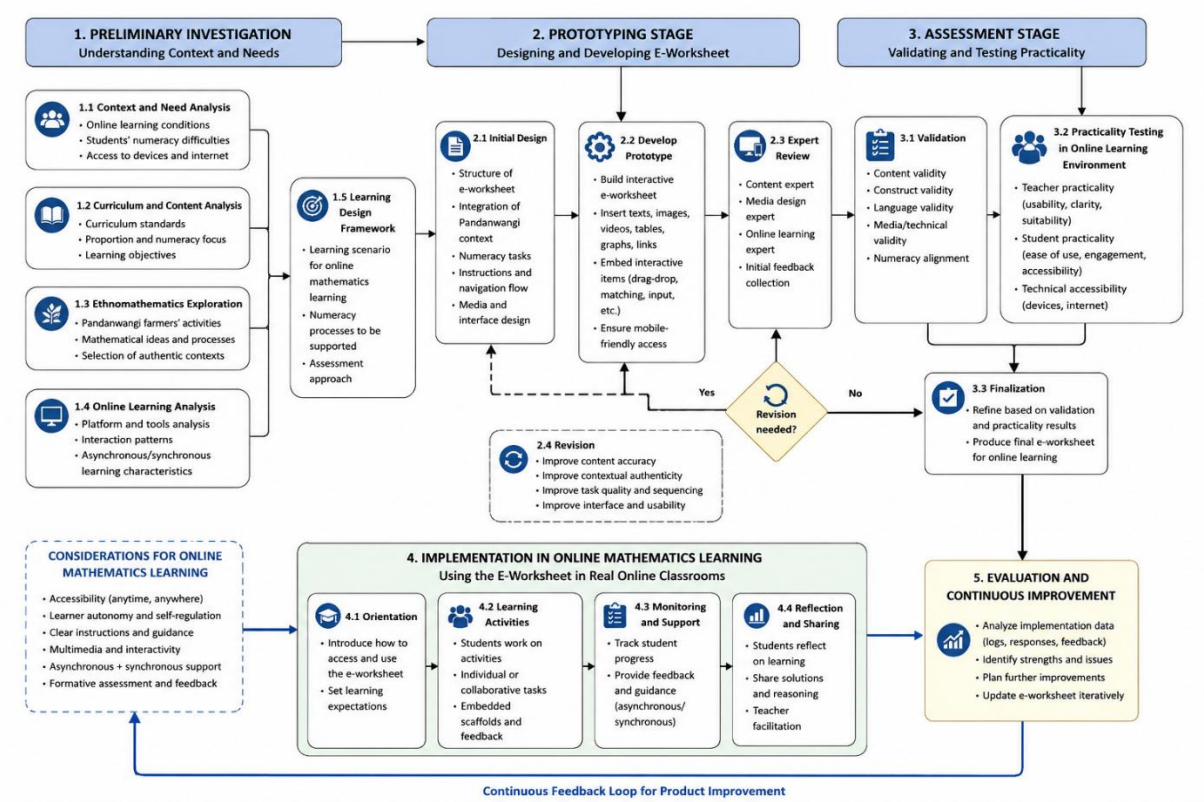
## 2. Methods

### 2.1 Research design

This research employed a research and development (R&D) approach to design an ethnomathematics-based e-worksheet integrating the activities of Pandanwangi rice farmers as contextual resources for supporting numeracy in online mathematics learning. The development procedure adopted three stages of the Plomp model: preliminary investigation, prototyping, and assessment (Plomp & Nieveen, 2010), as illustrated in Figure 1. The preliminary investigation involved identifying students' difficulties with proportion and numeracy-oriented tasks, analyzing relevant curriculum requirements, examining the characteristics of digital mathematics learning, and identifying mathematical ideas embedded in Pandanwangi farming practices that could be transformed into contextual problems. Particular attention was given to designing learning activities that students could follow through a digitally mediated environment with limited direct teacher assistance. The findings were subsequently translated into design specifications during the prototyping stage, including the organization of proportion content, sequencing of numeracy tasks, integration of Pandanwangi ethnomathematical contexts, digital navigation, instructions, visual representations, response formats, and interactive components. The prototype was therefore designed not merely as a digital version of a conventional worksheet, but as a structured online learning resource that guides students from interpreting authentic farming situations to identifying quantitative relationships, representing them mathematically, performing proportional reasoning, and interpreting the resulting solutions within their original contexts.

The assessment stage focused on determining whether this integration of ethnomathematical context, numeracy-oriented activities, and digital delivery resulted in an e-worksheet that was sufficiently valid and practical for use in online mathematics learning. Validity assessment examined the appropriateness and consistency of mathematical content, proportion concepts, numeracy processes, representation of Pandanwangi farming practices, instructional sequencing, language, media design, and technical characteristics of the digital worksheet. Practicality assessment examined the extent to which teachers and students could understand the instructions, navigate the e-worksheet, access and complete the activities, interpret the contextual information, and respond to the numeracy tasks within the intended digital learning environment. Feedback from these evaluations was used iteratively to revise the prototype, particularly where problems related to content clarity, contextual authenticity, task sequencing, interface usability, or online accessibility were identified. The assessment was deliberately limited to validity and practicality, and no effectiveness testing was conducted. Consequently, the study does not claim that the developed e-worksheet improves students' numeracy achievement; rather, it establishes whether the product constitutes a feasible, culturally contextualized, and usable digital resource for supporting numeracy-oriented mathematical activity in online learning.

Figure 1
*Plomp Development Stage*




## 2.2 Participants and Data Collections

The study was conducted at a public junior high school in Cianjur Regency, West Java, Indonesia. The school is located within an agricultural community in which Pandanwangi rice farming represents an important local activity, providing an authentic cultural setting for integrating ethnomathematical practices into mathematics learning. This setting was particularly relevant to the development of proportion-oriented numeracy tasks because quantitative relationships encountered in local farming activities could be reconstructed as contextual mathematical problems and subsequently delivered through the e-worksheet. The product evaluation involved two mathematics education lecturers serving as expert validators, one mathematics teacher, and ten seventh-grade students. The lecturers evaluated the e-worksheet from material and media-design perspectives, while the teacher and students participated in the practicality assessment. The student participants represented the intended users of the product and were involved in examining whether the digital learning activities, instructions, contextual problems, and navigation could be understood and used appropriately within an online mathematics learning environment.

Data were collected using expert validation sheets and practicality questionnaires. The validation sheets assessed the quality of the e-worksheet in terms of mathematical content, appropriateness of proportion and numeracy-oriented tasks, relevance of the Pandanwangi ethnomathematical context, language and instructional clarity, visual and media design, and suitability for digital delivery. Practicality questionnaires were

administered to the mathematics teacher and students to evaluate usability, clarity of instructions, ease of navigation, accessibility of learning activities, comprehensibility of contextual tasks, and overall suitability of the e-worksheet for online mathematics learning. All instruments employed Likert-scale responses and generated quantitative data. The resulting scores were analyzed using descriptive quantitative techniques by converting the obtained scores into percentage values and interpreting them according to predetermined validity and practicality criteria. The analysis was intended to establish whether the e-worksheet was sufficiently valid and practical as a culturally contextualized digital resource for supporting numeracy-oriented learning rather than to determine its effectiveness in improving students' numeracy outcomes.

### 2.3 Data Analysis

#### 2.3.1 Validity Analysis

Validator specialists evaluate validation aspects. Data analysis is utilized to test the validity, and a Likert scale with a score of 1-4 is used. The value of the validator's average score determines product validation. Table 1 shows the scales used in the validator's evaluation.

Table 1

*Validator rating category*

| Assessment Score | Category |
|---|---|
| 4 | Very Good |
| 3 | Good |
| 2 | Less Good |
| 1 | Not Good |

Guidelines for the calculation of the percentage score of the questionnaire validator is as follows:

$$P = \frac{\sum x}{\sum y} \times 100\ \% \qquad (1)$$

Description:

P = The percentage of the validity of

∑x = The number of overall respondents ' answers

∑y = Sum of the cur maximum

In decision-making used criteria based on the Table 2:

Table 2

*The percentage of the validation criteria of the media.*

| No. | Interval average score (%) | Category |
|---|---|---|
| 1 | 81.25< score ≤ 1.00 | Very Worthy |
| 2 | 62.5 < score ≤ 81.25 | Worthy |
| 3 | 43.75 < score ≤ 62.5 | Less Worthy |
| 4 | 25 < score ≤ 43.75 | Not Worthy |

The validity of the developed e-worksheet was assessed by expert validators using a four-point Likert scale. Each aspect was rated as Very Good (4), Good (3), Less Good (2), or Not Good (1), as presented in Table 1. The scores from all validators were then converted into percentages by comparing the total score obtained with the maximum

possible score. These percentages were used to determine the validity and feasibility of the e-worksheet according to the criteria in Table 2. A percentage above 81.25% was categorized as Very Worthy, 62.50%–81.25% as Worthy, 43.75%–62.50% as Less Worthy, and 25%–43.75% as Not Worthy. This analysis provided a simple quantitative basis for determining whether the e-worksheet was sufficiently valid to proceed to the practicality assessment.

### 2.3.2 Practicality Analysis

This practicality was obtained from a questionnaire given to teachers and students. Categorization of teacher and student responses was analyzed through percentage (%) using the following formula:

$$P = \frac{\sum x}{\sum y} \times 100\ \% \qquad (2)$$

Description:

P = The percentage of the validity

∑x = The number of overall respondents ' answers

∑y = Sum of the cur maximum.

Th e percentage obtained practicality, grouped according to the following criteria Table 3.

Table 3

*Percentage Criteria*

| No. | Interval average score (%) | Category |
|---|---|---|
| 1 | 81.25< score ≤ 1.00 | Very Practical |
| 2 | 62.5 < score ≤ 81.25 | Practical |
| 3 | 43.75 < score ≤ 62.5 | Less Practical |
| 4 | 25 < score ≤ 43.75 | Not Practical |

The practicality of the developed e-worksheet was assessed through questionnaires administered to the mathematics teacher and students after using the product. Their responses were analyzed descriptively by converting the total scores obtained into percentages based on the maximum possible score. The resulting percentages were then interpreted using the practicality criteria presented in Table 3. Scores above 81.25% were categorized as Very Practical, 62.50%–81.25% as Practical, 43.75%–62.50% as Less Practical, and 25%–43.75% as Not Practical. This analysis was used to determine the extent to which the e-worksheet was easy to understand, accessible, and convenient for teachers and students to use as a digital learning resource in online mathematics learning.

### 2.4 Ethical Clearance

Ethical considerations were addressed throughout the study to ensure the protection, privacy, and voluntary participation of all participants. Prior to data collection, permission to conduct the research was obtained from the participating school, and the teacher, students, and their parents or guardians were informed about the purpose, procedures, and intended use of the research data. Participation was voluntary, and participants were assured that their involvement or withdrawal would not affect their academic activities or assessment. Because the student participants were minors,

parental or guardian consent and student assent were obtained before participation. All responses collected through the validation sheets and practicality questionnaires were treated confidentially and reported anonymously, with no personally identifiable information disclosed. The digital use of the e-worksheet was also limited to research and learning purposes, and participants' data were not shared with unauthorized parties. The study followed applicable institutional research ethics procedures and ethical principles concerning informed consent, confidentiality, voluntary participation, and responsible management of research data.

## 3. Results and Discussion

### 3.1 Results

#### 3.1.1 Preliminary Investigation Stage

***a) Curriculum Analysis***

The curriculum analyzed in this study is Merdeka Curriculum. The curriculum analysis conducted is oriented to the achievement of competencies which include aspects of cognitive, attitudes, and skills. In this study, the preparation of teaching modules focused on e-worksheets. The preparation of the e-worksheet on Algebraic content is focused on comparatively valuable material oriented to Table 4. competency achievement Basic competencies and indicators of competency achievement.

Table 4

*Achievement of Basic Competence Competencies and Competency Achievement Indicators*

| Basic Competencies | Indicators of Competence Achievement |
|---|---|
| 3.8 Distinguishing direct proportion by using data tables, graphs, and equations | ○ Arrange tables Direct proportion<br>○ Finding the concept of direct proportion<br>○ Determining the value Direct proportion |
| Skill Competence | |
| 4.8 Solve problems related to direct proportion. | Solve problems in daily life related to direct proportion |

This analysis becomes a reference in preparing student achievement goals that are adjusted to indicators of numeracy abilities.

***b) Analysis of Students***

The subjects of this study were junior high school students in the 2021/2022 academic year. To determine the students' initial abilities, the researcher conducted an unstructured interview study. Some of the questions asked were "Can the teaching materials given by the teacher be understood? What teaching materials do students want to be able to learn mathematics? In what context are teaching materials used for students?

***c) Material Analysis***

This study selects material for a proportional analysis centered on direct proportions. Students participating in the research have been provided with foundational information, specifically fractions, decimals, and percentages. The researchers picked the

backdrop of Pandanwangi farmers' activities as ethnomathematical subjects based on the chosen materials.

***d) Needs Analysis***

Based on the results of unstructured interviews with mathematics teachers, it was found that the level of students' thinking skills was still low in solving abstract mathematical problems in geometry and algebra. The use of technology as an alternative to distance learning has not been optimally given to students. The teacher only gives assignments via WhatsApp. The teaching materials provided by the teacher in the form of books and assignments have not been able to optimize students' ability to think mathematically, especially the numeracy ability that students need to have. The teacher has never designed teaching materials that lead to numeracy problems. The teacher's understanding of numeracy is considered only a problem in the form of a story. The teacher does not understand the cognitive processes that are the components of numeracy so that in the preliminary study students experience obstacles in numeracy ability. Teaching materials in the context of students and even Cianjur culture have never been, for that teachers and students need technology design in teaching materials in particular to achieve learning objectives optimally. One alternative design is an e-module in the form of an e-worksheet which can support these obstacles.

**3.1.2 Prototyping Stage**

***a) Design Stage***

In the Development or Prototyping phase, the ethnomathematics-based e-worksheet was designed, developed, and evaluated based on the findings obtained from the preceding analysis phase. The e-worksheet was developed for Grade VII junior high school students and focused on the concept of direct proportion by integrating mathematical ideas with the activities of Pandanwangi rice farmers in Cianjur. At this stage, the learning content, activities, visual presentation, and ethnomathematical contexts were organized to ensure their suitability for students' cognitive level and their relevance to the mathematics curriculum.

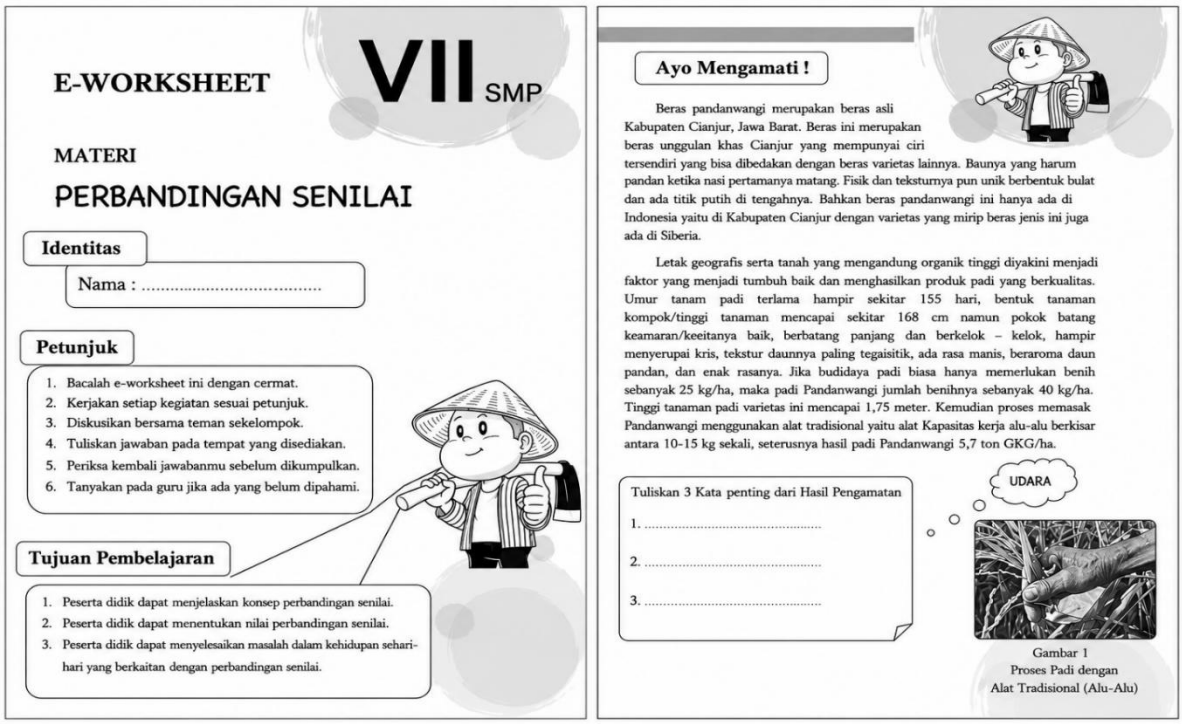
The e-worksheet was developed using Live Worksheets, an interactive platform that enables conventional worksheets to be transformed into web-based learning activities. The platform supports the integration of text, images, symbols, and interactive response formats, allowing students to engage directly with the learning materials. Students can complete different types of activities, including short-answer and true–false tasks, and receive immediate feedback on selected activities. The developed e-worksheet consists of six sheets covering learning objectives, observation and literacy activities, concept discovery, mathematical reasoning, practice, and evaluation.

Figure 1 presents the initial design of the ethnomathematics-based e-worksheet on direct proportion. The opening section provides the title, student identity field, instructions for completing the activities, and learning objectives. It is followed by an observation-based literacy activity that introduces the ethnomathematical context of Pandanwangi rice farming in Cianjur. Information related to Pandanwangi rice cultivation, such as planting duration, seed requirements, plant height, traditional

processing, and production yield, is presented as a contextual foundation for subsequent mathematical activities. In this way, the e-worksheet connects the concept of direct proportion with situations derived from the students' local cultural and agricultural environment, providing a meaningful context for developing mathematical understanding.

Figure 1

*Initial Design of the Ethnomathematics-Based E-Worksheet Integrating Pandanwangi Rice Farming Context*




The subsequent design of the e-worksheet focuses on guiding students from concept discovery to the application and reasoning stages. As presented in Figure 2, the activities are structured around the ethnomathematical context of Pandanwangi rice farming and are intended to help students construct the concept of direct proportion from contextual information rather than receiving the mathematical formula directly. The design builds upon the literacy activity introduced in the previous section, in which students have already acquired contextual information about Pandanwangi rice farming. This information is subsequently transformed into quantitative situations involving agricultural activities that can be interpreted mathematically.

In the concept discovery activity, students are presented with data relating the area of a Pandanwangi rice field to the amount of fertilizer required. For example, the worksheet provides an initial relationship between a field area of 1,000 $m^2$ and 25 kg of fertilizer and asks students to complete the remaining values in the table. Rather than merely performing numerical calculations, students are prompted to observe and analyze how changes in one quantity correspond to changes in another. They are then asked to determine whether the amount of fertilizer increases or decreases as the cultivated area changes and to express the relationship between the two quantities. Through this

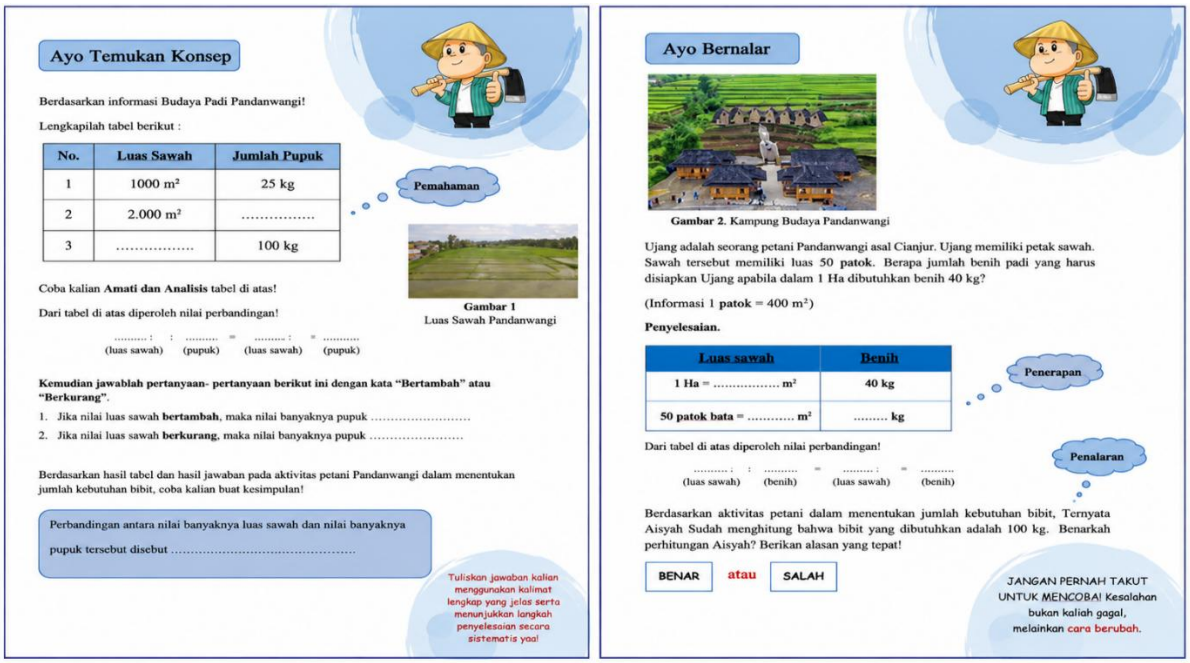
sequence, students are expected to recognize the invariant multiplicative relationship underlying direct proportion and formulate the concept based on the patterns they identify.

The activity then progresses from conceptual understanding to mathematical application and reasoning. Students are presented with another situation derived from Pandanwangi farming practices, involving the relationship between the area of a rice field and the amount of seed required. The contextual problem describes a farmer who owns 50 patok of rice fields, with one patok equivalent to 400 $m^2$, while 40 kg of rice seed is required for one hectare. Students must first interpret the local unit of measurement, convert the field area into standard units, establish the proportional relationship between field area and seed requirements, and subsequently determine the amount of seed needed. Thus, the ethnomathematical context serves not merely as an illustration but as the source of the mathematical problem that students need to model and solve.

The reasoning component further requires students to evaluate a proposed solution stating that 100 kg of seed is required for the given field area. Students must decide whether the statement is correct or incorrect and justify their decision mathematically. This activity moves beyond procedural calculation by requiring students to examine the reasonableness of a solution, relate it to the proportional relationship established previously, and communicate the reasoning supporting their judgment. Consequently, the sequence of activities is designed to develop students' conceptual understanding, application, and mathematical reasoning progressively within a culturally meaningful context.

Figure 2

*Concept Discovery and Mathematical Reasoning Activities on Direct Proportion in the Ethnomathematics-Based E-Worksheet*




Following the concept discovery and reasoning activities, the e-worksheet provides practice activities that allow students to consolidate and extend their understanding of

direct proportion. The practice tasks maintain the context of Pandanwangi farmers while presenting variations of proportional situations that require students to apply the concepts they have constructed independently. At this stage, students are expected to identify relevant quantities, determine proportional relationships, select appropriate mathematical procedures, perform calculations, and interpret their results according to the context of the problem. The gradual transition from guided concept discovery to more independent problem solving is intended to strengthen students' ability to transfer their understanding to related situations.

The final activities focus on evaluation and conceptual consolidation. Students are encouraged not only to obtain numerical answers but also to explain the relationships identified throughout the activities and formulate conclusions regarding the characteristics of direct proportion. In this way, the learning sequence progresses from contextual literacy and observation to concept discovery, application, reasoning, practice, and evaluation. The sequence enables students to connect their prior and culturally situated knowledge of Pandanwangi rice-farming activities with formal mathematical knowledge.

Overall, the design positions students as active constructors of mathematical knowledge. Familiar agricultural practices are transformed into mathematical situations involving quantities such as field area, fertilizer, seed requirements, and local units of measurement. By examining relationships among these quantities, students progressively move from contextual knowledge toward formal understanding of direct proportion. The e-worksheet therefore integrates ethnomathematical context with cognitive activities involving understanding, application, and reasoning, while simultaneously providing opportunities for students to develop numeracy, problem-solving, and mathematical communication skills.

### 3.1.3 Assessment Stage

#### *a) Validity Test Assessment*

After the learning media has been successfully developed, product validation is then carried out. Validation is a necessary process for researchers to reduce permissible errors in the creation of legitimate ethnomathematics-based e-worksheets. Validation is categorized by the assessment of materials and media by the validator according to expertise. The material validation was carried out by 2 material expert validators, whose names are presented in Table 5.

Table 5

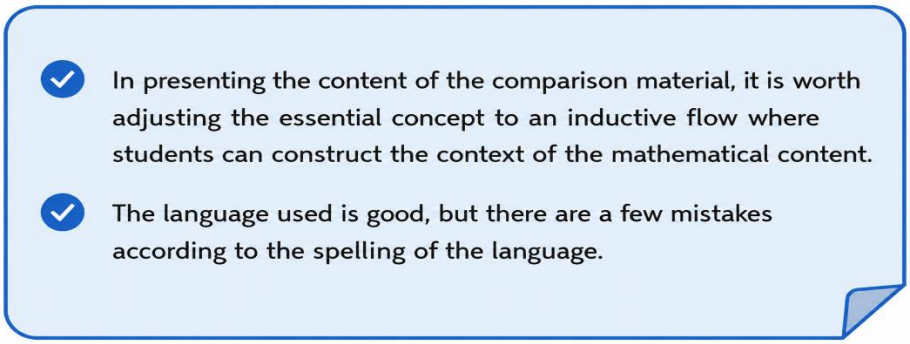
*Analysis Of Material Expert Validation Results*

| Rating Indicator | Validator 1 | Validator 2 |
|---|---|---|
| Content Eligibility | 88 % | 94 % |
| Material Presentation | 93 % | 95 % |
| Language | 87 % | 87 % |
| Validation Score | 92 % | 95 % |
| Category Validation | Very Good | Very Good |

Based on the results of the material expert's assessment of evaluating ethnomathematics-based e-worksheets on the validity of content, presentation of material, and language from Validator 1, a validation score of 92% was obtained with very good criteria and the results of the assessment from Validator 2 obtained a validation score of 95% with very good criteria. In addition, the validator provides comments or suggestions in writing on the validity of the e-worksheets shown in Figure 4.

Figure 3

*Comments or Suggestions of Material Validators on e-Worksheet Assessment*




The figure 3 presents expert feedback on the initial e-worksheet design, emphasizing the need to organize the direct proportion content through a more inductive learning sequence that enables students to construct mathematical concepts from contextual activities. The experts also considered the language generally appropriate, although several spelling and linguistic errors needed to be revised to improve clarity and accuracy. The media validation was carried out by 2 media expert validators, whose names are presented in Table 6.

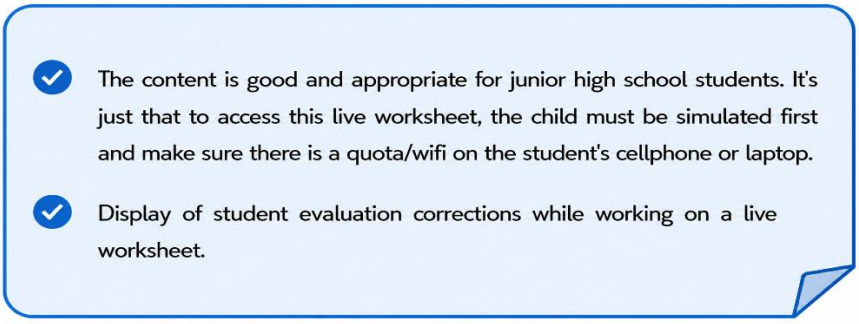
Table 6

*Analysis of Media Expert Validation Results*

| Rating Indicator | Validator 1 | Validator 2 |
|---|---|---|
| Material Aspect | 95 % | 95 % |
| Display Aspect | 93 % | 89 % |
| Utilization Aspect | 100 % | 100 % |
| Validation Score | 92 % | 93 % |
| Category Validation | Very Worthy | Very Worthy |

Based on the results of the assessment of media experts assessing ethnomathematics-based e-worksheets using a live worksheet on the material, display, and utilization aspects of Validator 1, a validation score of 92% was obtained with very worthy criteria, and the results of the assessment of Validator 2 obtained a validation score of 93% with very worthy criteria. In addition, the validator provides comments or suggestions in writing on the validation of e-worksheets media using the live worksheet shown in Figure 4.

Figure 4
*The overall assessment of media experts is decent*




The figure presents expert feedback indicating that the e-worksheet content is appropriate for junior high school students, while emphasizing the importance of ensuring students' readiness and reliable internet access when using Live Worksheets. The experts also recommended providing immediate correction or feedback on students' responses during the evaluation activities to support more effective interactive learning. Based on the validity assessors from material and media experts, ethnomathematics-based e-worksheets are assisted by live worksheets to understand mathematical concepts in comparatively valuable materials in the valid category.

***b) Practicality Test Assessment***

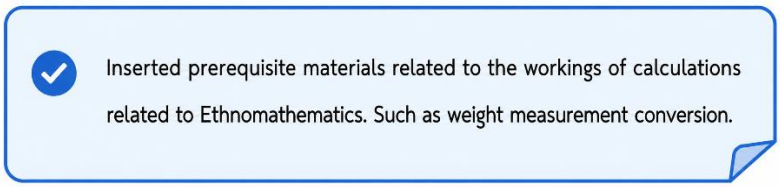
Student response questionnaires were given to 10 students who had used e-worksheets. The teacher response questionnaire was given to one mathematics teacher who had used e-worksheets during learning. E-worksheets are piloted for one week or 2 meetings. Table 7 is the result of practical e-worksheets.

Table 7
*Practical Results of E-worksheets*

| No. | Questionnaire | Score Percentage | Practicality Category |
|---|---|---|---|
| 1. | Student Response | 76 % | Practical |
| 2. | Teacher's Response | 95 % | Very Practical |

According to the findings from student and teacher questionnaires, student replies yielded an average percentage score of 76% categorized as practical, while instructor responses achieved an average percentage score of 95% classified as highly practical. In addition, the teacher provides comments or suggestions in writing on the practicality of the e-worksheets shown in Figure 5.

Figure 5
*Teacher's Comments or Suggestions on e-Worksheets Assessment*

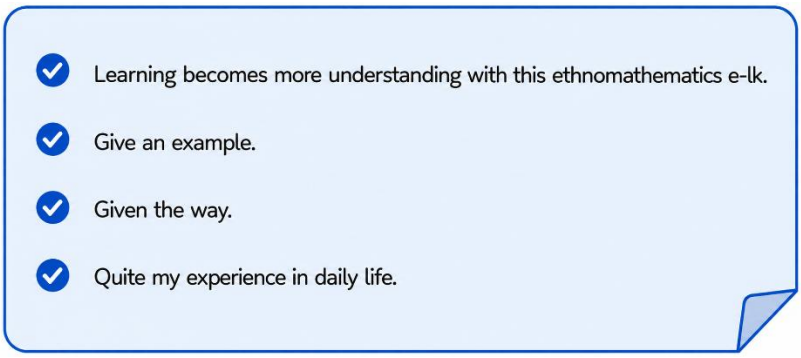



The figure 5 presents expert feedback recommending the inclusion of prerequisite mathematical concepts before students engage with ethnomathematics-based direct

proportion activities. In particular, students need to understand measurement conversions, such as converting units of weight, to support calculations related to Pandanwangi rice farming activities. This prerequisite knowledge is expected to help students connect local farming practices with formal mathematical concepts more effectively. Meanwhile, students provide comments or suggestions in writing on the practicality of the e-worksheets shown in Figure 6.

Figure 6

*Student Comments or Suggestions on e-Worksheet Assessment*




The figure 6 presents students' feedback indicating that the ethnomathematics-based e-worksheet helps make the learning material easier to understand by connecting mathematics with familiar real-life experiences. Students also suggested providing more examples and clearer guidance on the steps for solving the mathematical problems. Overall, the feedback indicates that contextualizing direct proportion through Pandanwangi farming activities makes the learning content more relevant to students' everyday experiences.

### 3.2 Discussion

Based on the practical assessments from teachers and students, ethnomathematics-based e-worksheets are assisted by live worksheets to understand mathematical concepts in comparatively valuable material in the practical category. Incorporating cultural components into the mathematics curriculum promotes active student engagement in their academic pursuits (Amit & Abu Qouder, 2017). Integrating mathematics with students' social culture entails the application of ethnomathematics in education. Ethnomathematics seeks to empower students as active participants in the construction of knowledge. Incorporating ethnomathematical learning tools in the classroom can facilitate significant educational experiences (Vitoria & Monawati, 2020). U. Husna et al., (2018) the ethnomathematical approach enhances the relevance and significance of mathematics education for pupils. Research has shown that mathematics education grounded in mathematical concepts can transform students' conceptions of the connection between mathematics and reality, as well as their cultural (Prahmana & D'Ambrosio, 2020). Consequently, students can perceive the interrelation between mathematics and their surrounding culture, enabling them to comprehend the significance of the mathematical concepts they acquire and utilize them in their everyday lives (Abdullah et al., 2019; Risdiyanti & Indra Prahmana, 2020; Risdiyanti & Prahmana, 2018). Teachers may foster a welcoming classroom climate where all students feel safe to

ask questions and share their perspectives on mathematics by bringing ethnomathematics into the curriculum.

The research by and share their perspectives on mathematics by bringing ethnomathematics into the curriculum.Johnson et al., (2022) indicates that the incorporation of cultural elements enhances students' engagement and affinity for mathematics. Students and parents in Dutch schools exhibit increased interest in educational help when the curriculum incorporates a cultural perspective. Ultimately, for persons who can integrate ethnomathematics into educational mathematics, its application can augment the relevance and practicality of mathematics for all students. Previous studies reveal that applying ethnomathematics is beneficial for student learning (D'Ambrosio, 2001; Pais, 2011). Learning mathematics with culture tends to be more motivating because they feel the need to understand it. (Brandt & Chernoff, 2014). This study also revealed that traditional games originating from a motivating culture provide a meaningful context for children to play math ideas and skills and improve their numeracy ability (Franco et al., 2021). How children use literacy, numeracy, and language through culture-based games. Literacy and numeracy skills are basic skills that must be possessed by students in Indonesia through a minimum competency assessment. The context in the matter of numeracy, which is the basic reference for existing abilities in Indonesia, is one of the socio-cultural aspects of students. The teachers can optimize one of the numeracy abilities through the cultural context through ethnomathematics. Through the application of ethnomathematics in teaching materials, students can understand the objectives of learning mathematics. The worksheet is one of the teaching materials that can improve students' skills in analyzing and solving problems independently and changing spending to be student-centered, increasing student learning achievement (Sagita et al., 2021). In addition, incorporating ethnomathematics in teaching materials can also help students appreciate and value diverse cultural perspectives in mathematics, promoting inclusivity and respect for different ways of understanding numerical concepts. By recognizing and incorporating students' cultural backgrounds and experiences in math education, teachers can create a more engaging and meaningful learning environment that fosters critical thinking and problem-solving skills. Ibu This method can enhance students' connection to the topic and increase their motivation to learn.

The findings of this study show that the ethnomathematics-based e-worksheet integrating numeracy skills into comparison material derived from Pandanwangi rice farmers' activities achieved a *very valid* classification based on expert evaluations, with an overall validity percentage of 80.5%. More specifically, the media design expert and learning material expert evaluations yielded average scores of 76% and 72%, respectively. These results indicate that while the product is generally strong in terms of content accuracy and design, there remain aspects particularly in learning material structure and pedagogical alignment that could be further refined to enhance its robustness.

In terms of practicality, the e-worksheet was rated by mathematics teachers and students as very practical, with respective scores of 77% and 88%. The higher rating from students suggests that the contextual integration of Pandanwangi rice farming activities may have increased engagement and accessibility for learners, while teachers' slightly lower rating may point to certain instructional or technical considerations that require attention, such as the adaptability of the material to varied teaching styles or classroom conditions.

These findings are consistent with previous studies (Hirzi & Gazali, 2020; N. Husna et al., 2021b; Setiawan et al., 2021; Sowanto & Mulyadin, 2019; Vitoria & Monawati, 2020; Zuhra et al., 2021,), which collectively affirm that ethnomathematics-based learning resources generally meet the criteria of validity, practicality, and effectiveness. However, this study adds nuance by demonstrating that the effectiveness of ethnomathematics integration may differ between expert reviewers, teachers, and students. Such differences suggest that while cultural contextualization enriches learning experiences, the design must also carefully balance curricular demands, pedagogical clarity, and user-friendliness for both educators and learners.

The high practicality ratings further indicate that the e-worksheet successfully incorporates ethnomathematics into classroom practice, supporting learners' conceptual understanding by situating proportion concepts within familiar cultural contexts. Nonetheless, the variation in expert validation scores signals an opportunity for further development, particularly in strengthening instructional coherence and enhancing multimedia elements to support different learner needs. Overall, the use of a valid and practical ethnomathematics-based e-worksheet demonstrates its potential to improve mathematics learning outcomes. However, continued refinement and iterative evaluation are essential to ensure that the integration of cultural knowledge not only enhances engagement but also maintains strong pedagogical rigor across diverse educational settings.

The worksheet is useful as a teacher guide to direct students in the learning process to achieve the competencies taught, student guidelines in achieving learning objectives, and evaluation guidelines for the achievement of results (Sutarni et al., 2024). Hui et al. (2023) states that the application of culture in learning is a means to motivate and stimulate students in order to overcome boredom and difficulties in learning mathematics. The application of ethnomathematics can increase students' positive attitudes toward mathematics and improve learning outcomes (Rosa & Orey, 2013; Zuhra et al., 2021) Ethnomathematics can also increase students' appreciation of local culture and influence the way they behave in society (D'Ambrosio, 2001). Ethnomathematics reflects the culture and can be applied to the education system (Dewolf et al., 2014). The ethnomathematical approach has proven to be interesting, influences critical thinking skills, and fosters a love for local culture (Suherman et al., 2021). This finding is an alternative for teachers and other researchers in compiling teaching materials through worksheet in an ethnomathematical context that is close to the student environment.

Hopefully, this research can contribute to a comprehensive ethnomathematical context that can be used as a reference in compiling teaching materials in the future.

**Limitations**

To optimize the use of the GeoGebra Application based on student worksheets in improving understanding of three dimensions, it is recommended to add cultural context to the GeoGebra Application based on student worksheets so that students' prior knowledge can be connected to new mathematical content in students.

**Future Study**

Future studies should extend the present development beyond validity and practicality testing by examining the effectiveness of the ethnomathematics-based e-worksheet in supporting students' numeracy through online mathematics learning. Experimental or quasi-experimental studies involving larger and more diverse samples are recommended to investigate changes in numeracy performance, particularly students' ability to interpret contextual information, formulate mathematical relationships, apply proportion concepts, and evaluate solutions in real-world situations. Further research could also examine students' engagement, learning independence, and interaction with the e-worksheet in fully online or blended learning environments. In addition, the Pandanwangi ethnomathematical context could be expanded to other mathematical topics and grade levels, while comparative studies could explore whether locally contextualized digital resources provide different learning experiences from conventional e-worksheets. Such investigations would provide stronger empirical evidence regarding the contribution of culturally contextualized digital materials to numeracy and online mathematics education.

## 4. Conclusion

The ethnomathematics-based e-worksheet integrating the activities of Pandanwangi rice farmers was found to be valid and practical as a digital resource for supporting numeracy in online mathematics learning. Expert evaluations by media design and learning material specialists consistently placed the product in the very valid category, demonstrating the appropriateness of its mathematical content, contextual integration, instructional design, and digital presentation. Practicality assessments from the teacher and students further indicated that the e-worksheet was understandable, accessible, and usable for learning activities. More importantly, the developed e-worksheet demonstrates that online mathematics learning can extend beyond the digital delivery of conventional exercises by incorporating authentic cultural practices into digitally mediated mathematical activities. Through proportion tasks derived from Pandanwangi farming practices, the e-worksheet connects students' local experiences with formal mathematical representations and numeracy-oriented problem solving. However, as the study was limited to validity and practicality assessment, these findings establish the feasibility of the e-worksheet rather than its effectiveness in improving students' numeracy outcomes.

The study contributes to mathematics education by demonstrating how ethnomathematics, numeracy, and online learning can be pedagogically connected through e-worksheet design. Rather than treating digitalization and contextualization as separate dimensions, the developed product positions the e-worksheet as a digital bridge through which locally situated mathematical knowledge can be transformed into accessible online learning activities. Pedagogically, this approach provides teachers with a model for designing online mathematics resources that maintain connections between abstract concepts and students' cultural and everyday environments. For distance and online mathematics education, the findings suggest that flexibility of access should be accompanied by meaningful contextualization so that digital learning does not merely reproduce decontextualized mathematical exercises. The study therefore extends the role of ethnomathematics from a classroom-based contextual approach to a potential design foundation for culturally responsive digital mathematics resources, while providing an initial empirical basis for their further development and effectiveness testing in broader online learning settings.

**Acknowledgments**

The authors would like to express their sincere appreciation to the school, mathematics teacher, students, and expert validators who participated in and supported this study. The authors also acknowledge all parties who contributed valuable feedback during the development and evaluation of the ethnomathematics-based e-worksheet integrating Pandanwangi farming activities for online mathematics learning.

**Author Contributions**

All authors contributed to the conception and design of the study. The research activities included the exploration of Pandanwangi ethnomathematical contexts, development of the e-worksheet, preparation of research instruments, data collection, analysis and interpretation of the findings, and preparation of the manuscript. All authors critically reviewed the manuscript, approved the final version, and agreed to be accountable for the integrity of the work.

**Funding Statement**

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

**Conflict of Interest**

The authors declare that they have no financial, professional, or personal conflicts of interest that could have influenced the conduct, interpretation, or reporting of this study.

**Data Availability Statement**

The data supporting the findings of this study are available from the corresponding author upon reasonable request. Data containing information related to research participants are not publicly available to protect participants' privacy and confidentiality.

**AI Use Declaration**

Generative artificial intelligence tools were used solely to assist with language refinement and improve the clarity and readability of the manuscript. AI tools were not used to generate research data, conduct data analysis, interpret the findings, or make research

decisions. All AI-assisted content was critically reviewed and verified by the authors, who take full responsibility for the accuracy, integrity, and final content of the manuscript.

## 5. References

Abdullah, A. H., Rahman, S. N. S. A., Mokhtar, M., Hairon, S. M., Ibrahim, N. H., & Mun, S. H. (2019). Behaviours of Students When Solving the Assessment of Programme for International Student Assessment (PISA) Mathematical Problems. In *Proceedings of the 2018 IEEE 10th International Conference on Engineering Education, ICEED 2018* (pp. 224–229). https://doi.org/10.1109/ICEED.2018.8626932

Aulia, P. A., Sugiarni, R., & Rodríguez-Nieto, C. A. . (2025). Development and validation of ethnomathematics-based worksheets integrating Sundanese Pupuh for enhancing number pattern learning in Indonesian secondary schools. *Polyhedron International Journal in Mathematics Education*, *3*(2), 139–152. https://doi.org/10.59965/pijme.v3i2.275

Amit, M., & Abu Qouder, F. (2017). Weaving Culture and Mathematics in the Classroom: The Case of Bedouin Ethnomathematics. *Ethnomathematics and Its Diverse Approaches for Mathematics Education, 23–50*. https://doi.org/10.1007/978-3-319-59220-6_2

Arion, K. (2024). Exploring local wisdom: utilizing ethnomathematics to improve mathematical creative thinking skills. *Jurnal THEOREMS (The Original Research of Mathematics), 9*(1), 100–113. https://doi.org/10.31949/th.v9i1.9538

Aziz, R. C., Chea, C. C., & Ismail, Z. (2021). Nurturing Numeracy Literacy Via Online Learning: A Case Study on the Effectiveness of the Online Forum Discussion. International Conference on Education (ICE 2021), 13(Ice), 184–194.

Bantaika, A., Son, A. L., Ndapa Deda, Y., & Garcia-Garcia, J. (2025). Mathematical concepts and cultural values in guest reception traditions: an ethnomathematic study of the Dawan Tribe Community on The Timor Island. *International Journal of Didactic Mathematics in Distance Education*, *2*(1), 32–44. https://doi.org/10.33830/ijdmde.v2i1.9702

Brandt, A., & Chernoff, E. (2014). The Importance of Ethnomathematics in the Math Class. *Ohio Journal of School Mathematics, 71*, 31–36.

Cockcroft, W. . (1982). Mathematics Counts. In Report of the Committee of Inquiry into the Teaching of Mathematics in Schools in England and Wales. HM Stationery Office London.

D'Ambrosio, U. (2001). General remarks on ethnomathematics. *ZDM - International Journal on Mathematics Education, 33*(3), 67–69. https://doi.org/10.1007/BF02655696

Dewolf, T., Van Dooren, W., Ev Cimen, E., & Verschaffel, L. (2014). The impact of illustrations and warnings on solving mathematical word problems realistically. *Journal of Experimental Education, 82*(1), 103–120. https://doi.org/10.1080/00220973.2012.745468

Fointuna, D. W. (2021). Applying Mamdani's method to categorize mathematical literacy of public middle school students in Kupang. *Journal of Physics: Conference Series, 1957*(1), 012009. https://doi.org/10.1088/1742-6596/1957/1/012009

Franco, J., Orellana, M. F., & Franke, M. L. (2021). 'Castillo blueprint': How young children in multilingual contexts demonstrate and extend literacy and numeracy practices in play. *Journal of Early Childhood Literacy, 21*(3), 361–387. https://doi.org/10.1177/1468798419841430

Hirzi, R. H., & Gazali, M. (2020). Ethnomathematic Worksheet by Scientific Aproachs. *Journal of Physics: Conference Series, 1539*(1), 012078. https://doi.org/10.1088/1742-6596/1539/1/012078

Hui, H. B., & Mahmud, M. S. (2023). Influence of game-based learning in mathematics education on the students' cognitive and affective domain: A systematic review. *Frontiers in psychology*, *14*, 1105806. https://doi.org/10.3389/fpsyg.2023.1105806

Husna, N., Saminan, & Abidin, Z. (2021a). Development of student worksheets on ethnomathematics-based trigonometry through Project-Based Learning models. *Journal of Physics: Conference Series, 1882*(1). https://doi.org/10.1088/1742-6596/1882/1/012071

Husna, N., Saminan, & Abidin, Z. (2021b). Development of student worksheets on ethnomathematics-based trigonometry through Project-Based Learning models. In *Journal of Physics: Conference Series (Vol. 1882, Issue 1)*. https://doi.org/10.1088/1742-6596/1882/1/012071

Isnawan, M. G., & Alsulami, N. M. (2024). Didactical design for online learning in ordering fractions. *International Journal of Didactic Mathematics in Distance Education*, *1*(1), 1–12. https://doi.org/10.33830/ijdmde.v1i1.7653

Johnson, J. D., Smail, L., Corey, D., & Jarrah, A. M. (2022). Using bayesian networks to provide educational implications: mobile learning and ethnomathematics to improve sustainability in mathematics education. *Sustainability (Switzerland), 14*(10), 5897. https://doi.org/10.3390/su14105897

Kolar, V. M., & Hodnik, T. (2021). Mathematical literacy from the perspective of solving contextual problems. In European Journal of Educational Research (Vol. 10, Issue 1, pp. 467–483). https://doi.org/10.12973/EU-JER.10.1.467

Kurniasi, E. R., Vebrian, R., & Arsisari, A. (2022). Development of student worksheets based computational thinking for derivatives of algebra function. *JTAM (Jurnal Teori Dan Aplikasi Matematika), 6*(1), 212. https://doi.org/10.31764/jtam.v6i1.6022

Lestari, P. C., Miriam, S., & Misbah, M. (2021). Science literacy-based sound wave e-worksheet: Validity aspects. Journal of Physics: Conference Series, 2104(1), 012010. https://doi.org/10.1088/1742-6596/2104/1/012010

Marlina, E., & Azis, F. (2023). The ethnomathematical concept of sundanese local wisdom through building space for the Earth Alit Kabuyutan West Java site as the

development of mathematics learning media. *International Journal of Quantitative Research and Modeling, 4*(2), 76–81. https://doi.org/10.46336/ijqrm.v4i2.449

Muhaimin, L. H., Sholikhakh, R. A., Yulianti, S., Ardani, Hendriyanto, A., & Sahara, S. (2024). Unlocking the secrets of students' mathematical literacy to solve mathematical problems: A systematic literature review. *Eurasia Journal of Mathematics, Science and Technology Education, 20*(4), em2428. https://doi.org/10.29333/ejmste/14404

Muir, T. (2008). Principles of practice and teacher actions: Influences on effective teaching of numeracy. *Mathematics Education Research Journal, 20*(3), 78–101. https://doi.org/10.1007/BF03217531

Namisango, E., Bristowe, K., Murtagh, F. E., Downing, J., Powell, R. A., Atieno, M., ... & Harding, R. (2022). Face and content validity, acceptability, feasibility, and implementability of a novel outcome measure for children with life-limiting or life-threatening illness in three sub-Saharan African countries. *Palliative medicine*, *36*(7), 1140-1153. https://doi.org/10.1177/026921632210995

Pakabu, K. T. S., Sudirman, S. ., Kandaga , . T. ., Rodríguez-Nieto, C. A. ., & Dejarlo, J. O. (2024). Developing Papuan cultural contextual E-Module learning devices in linear programs to improve students' mathematical problem-solving skills. *International Journal of Mathematics and Sciences Education*, *2*(1), 25–42. https://doi.org/10.59965/ijmsed.v2i1.107

Pais, A. (2011). Criticisms and contradictions of ethnomathematics. *Educational Studies in Mathematics, 76*(2), 209–230. https://doi.org/10.1007/s10649-010-9289-7

Plomp, T., & Nieveen, N. M. (2010). An introduction to educational design research. Educational Design Research, 1, 11–50.

Prabowo, A. (2021). Penggunaan Liveworksheet dengan Aplikasi Berbasis Web untuk Meningkatkan Hasil Belajar Peserta Didik [The Use of Liveworksheets with Web-Based Applications to Improve Student Learning Outcomes]. *Jurnal Pendidikan Dan Teknologi Indonesia, 1*(10), 383–388. https://doi.org/10.52436/1.jpti.87

Prahmana, R. C. I., & D'Ambrosio, U. (2020). Learning geometry and values from patterns: Ethnomathematics on the batik patterns of yogyakarta, indonesia. *Journal on Mathematics Education, 11*(3), 439–456. https://doi.org/10.22342/jme.11.3.12949.439-456

Risdiyanti, I., & Indra Prahmana, R. C. (2020). The learning trajectory of number pattern learning using barathayudha war stories and uno stacko. *Journal on Mathematics Education, 11*(1), 157–166. https://doi.org/10.22342/jme.11.1.10225.157-166

Risdiyanti, I., & Prahmana, R. C. I. (2018). Ethnomathematics: Exploration in Javanese culture. In Journal of Physics: Conference Series (Vol. 943, Issue 1). https://doi.org/10.1088/1742-6596/943/1/012032

Rosa, M., & Orey, D. C. (2013). Ethnomodelling as a Methodology for Ethnomathematics. In International Perspectives on the Teaching and Learning of Mathematical Modelling (pp. 77–88). https://doi.org/10.1007/978-94-007-6540-5_6

Sagita, L., Setiyani, & Sumiarsih. (2021). Designing teaching materials based on process skills approach to mathematical representation ability in polyhedron. In S. U., N. F., Y. W., L. I., & S. R. (Eds.), *Journal of Physics: Conference Series (Vol. 1957, Issue 1). IOP Publishing Ltd*. https://doi.org/10.1088/1742-6596/1957/1/012015

Segers, E., Kleemans, T., & Verhoeven, L. (2015). Role of parent literacy and numeracy expectations and activities in predicting early numeracy skills. *Mathematical Thinking and Learning, 17*(2–3), 219–236. https://doi.org/10.1080/10986065.2015.1016819

Setiawan, H., Fauzan, A., & Arnawa, I. M. (2021). The development of geometrical learning devices based on rumah gadang ethnomathematics for grade VII junior high school. *Journal of Physics: Conference Series, 1742*(1). https://doi.org/10.1088/1742-6596/1742/1/012003

Sholihah, M., Widadah, S., & Sukriyah, D. (2022). Development of Student Worksheet Based on Ethnomathematics Traditional Engklek Games on Cube and Rectangular Pyramid . *Proceedings of the Eighth Southeast Asia Design Research (SEA-DR) & the Second Science, Technology, Education, Arts, Culture, and Humanity (STEACH) International Conference (SEADR-STEACH 2021)*, 627, 144–152. https://doi.org/10.2991/assehr.k.211229.023

Sowanto, & Mulyadin, E. (2019). Developing of teaching materials for junior high school students based on ethnomathematics on traditional woven cloth (Tembe Nggoli) of Mbojo tribe. *In Journal of Physics: Conference Series (Vol. 1280, Issue 4).* https://doi.org/10.1088/1742-6596/1280/4/042044

Sugiarni, R., Herman, T., Septian, A., Fazrianto Suwarman, R., & Inayah, S. (2023). Analysis of errors and difficulties on numeracy ability students in the new normal era. Proceedings of the 3Rd Ahmad Dahlan International Conference on Mathematics and Mathematics Education 2021, 2733(1), 030032. https://doi.org/10.1063/5.0140355

Sugiarni, R., Inayah, S., & Suwarman, R. F. (2019). Student worksheets for e-learning models based on environmental projects on geometry topics in spreading literacy culture. *In International Journal of Scientific and Technology Research* (Vol. 8, Issue 10, pp. 418–422).

Suherman, Rahmadani, N. A., Vidákovich, T., Mujib, Fitria, N., Sari Putri, N. I., Addarojat, M. R. U., & Priadi, M. (2021). SQ3R method assisted by ethnomathematics-oriented student worksheet: The impact of mathematical concepts understanding. *In IOP Conference Series: Earth and Environmental Science* (Vol. 1796, Issue 1). https://doi.org/10.1088/1742-6596/1796/1/012059

Sutarni, S., Sutama, S., Prayitno, H. J., Sutopo, A., & Laksmiwati, P. A. (2024). The development of realistic mathematics education-based student worksheets to enhance higher-order thinking skills and mathematical ability. *Infinity Journal*, *13*(2), 285-300. https://doi.org/10.22460/infinity.v13i2.p285-300

Syaifuddin, M. (2022). Minimum Competency Assessment to Measure Mathematical Literacy of Junior High School Students. *Journal of Education Research and Evaluation, 6*(2), 316–326. https://doi.org/10.23887/jere.v6i2.46263

Taufiqoh, T., Supratman, S., & Ni'mah, K. (2023). Development of AKM-Based mathematics questions in the adiwiyata context to train students' numeracy skills. *Numerical: Jurnal Matematika dan Pendidikan Matematika, 7*(2), 359–372. https://doi.org/10.25217/numerical.v7i2.3729

Vitoria, L., & Monawati. (2020). Developing ethnomathematics-based worksheet to teach linear equations. Journal of Physics: Conference Series, 1460(1). https://doi.org/10.1088/1742-6596/1460/1/012021

Wijaya, H., Maryanti, R., Wulandary, V., & Irawan, A. R. (2022). Numerical Minimum Competence Assessment for Increasing Students' Interest in Mathematics. *ASEAN Journal of Science and Engineering Education, 2*(3), 183–192. https://doi.org/10.17509/AJSEE.V2I3.38660

Yanto, D. T. P., Ganefri, G., Sukardi, S., Yanto, J. P., Samala, A. D., Dewi, I. P., ... & Kabatiah, M. (2024). Innovative laboratory learning: A study evaluating the practicality of integrated e-worksheets with augmented reality in electrical machines course. *International Journal of Information and Education Technology*, *14*(7), 996-1005. https://doi.org/10.18178/ijiet.2024.14.7.2127

Zuhra, M., Anwar, & Mailizar. (2021). The development of ethnomathematics-based mathematics students worksheet for junior high schools using contextual approach. *AIP Conference Proceedings, 2331*. https://doi.org/10.1063/5.0045499