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# Development of lampung culture-based student worksheet integrating ethnomathematics and whole language for mathematical communication

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**Abstract**

Students' mathematical communication skills need support through meaningful, contextual learning resources that connect mathematics to students' cultural environment. This study aimed to develop a Lampung-culture-based student worksheet that integrates ethnomathematics and the whole language approach to support students' mathematical communication skills. This research used the Research and Development method with the Borg and Gall development model. The preliminary field test involved 15 ninth-grade students, while the main field test involved 51 ninth-grade students from junior high schools. The schools and participants were selected using purposive sampling based on predetermined criteria, including implementation of the SPLDV topic, availability of required learning facilities, and the school's willingness to participate in the study. Data were analyzed using descriptive quantitative methods based on expert validation scores and teacher and student responses. The developed student worksheet integrates Lampung cultural contexts with mathematical activities through motivation, cultural introductions, instructional videos accessed via QR codes, reading, group discussions, exploration of various learning resources, written problem-solving, and presentations. Validation results showed that the student worksheet met the validity criteria and was suitable for use in mathematics instruction. Integrating cultural contexts and the whole language approach gives students opportunities to listen, read, speak, and write as they communicate mathematical ideas. The study concludes that the developed student worksheet is a valid and practical learning resource that integrates Lampung culture, ethnomathematics, and Whole Language for junior high school mathematics learning.

**Keywords**: Ethnomathematics; Lampung Culture; Mathematical Communication; Student Worksheet; Whole Language

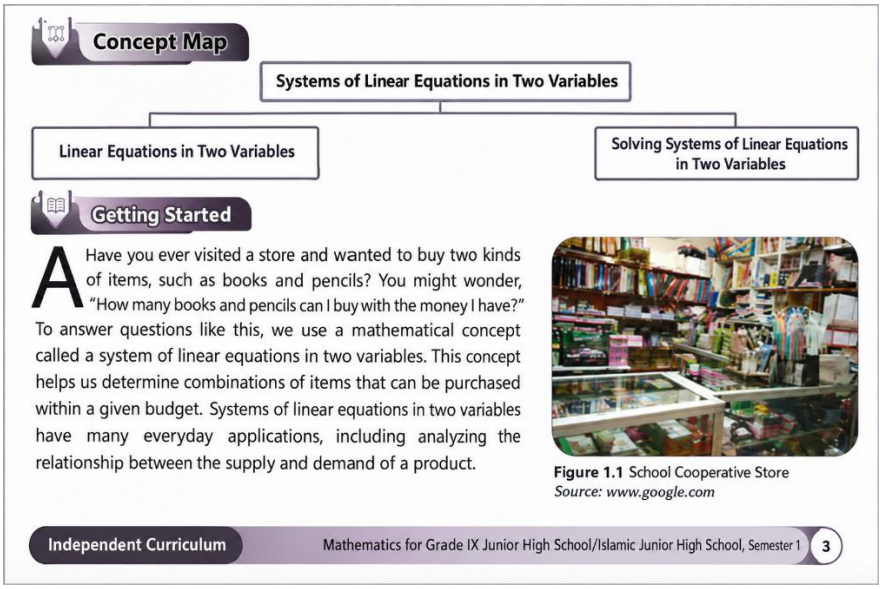
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## INTRODUCTION

Mathematical communication skills are essential for learning mathematics because students need to understand, represent, explain, and communicate mathematical ideas clearly. These skills involve using mathematical symbols and representations appropriately, identifying relevant information, explaining solution strategies, and drawing logical conclusions (Cai et al., 1996; Gardenia et al., 2021). (Zulkarnain et al., 2021) identify three main aspects of

mathematical communication: grammar skills, discourse comprehension skills, and strategic ability.

A preliminary survey was conducted in two junior high schools in Lampung Province. The survey involved four mathematics teachers, two from each school, and 30 ninth-grade students, 15 from each school. Data were collected through unstructured interviews with teachers and students to explore mathematics learning practices, the use of learning resources, the integration of Lampung culture into mathematics learning, and the use of student worksheets. The interview data were analyzed descriptively to identify learning conditions and needs. The findings showed that mathematics learning had not yet been meaningfully integrated with Lampung culture, and the student worksheets used in the schools did not integrate Lampung cultural contexts. Although students had been introduced to Lampung culture, the exposure was generally limited to cultural recognition rather than to its use as a context for mathematics learning. The Systems of Linear Equations in Two Variables materials used in schools also did not incorporate local cultural contexts (Figure 1).




*Source: Researcher's documentation, 2026*

**Figure 1** Systems of Linear Equations in Two Variables Learning Materials Used in Schools

Figure 1 shows that mathematics learning in schools has not yet integrated local culture, particularly Lampung culture. Evidence from the preliminary survey was obtained from two one junior high schools in Lampung Province, involving four mathematics teachers and 15 ninth-grade students. The analysis of learning materials supported by unstructured interviews with teachers and students, showed that the worksheets focused mainly on mathematical concepts and exercises and did not integrate Lampung cultural contexts. These findings indicate

a need for student worksheets that incorporate Lampung culture into mathematics learning. Interviews with mathematics teachers indicated that students tended to have difficulties with reasoning problems and were more accustomed to memorizing formulas than understanding concepts. Students also had difficulty explaining mathematical ideas and solution strategies orally or in writing. A contextual Systems of Linear Equations in Two Variables problem used in the preliminary study is presented in Figure 2.

> Tina buys 4 kg of snake fruit and 1 kg of oranges for IDR 25,000. Rena buys 1 kg of snake fruit and 4 kg of oranges for IDR 37,000. How much does 1 kg of snake fruit cost?

**Figure 2.** Contextual Systems of Linear Equations in Two Variables Problem Used in the Preliminary Study

Students' responses to the problem showed that some students were unable to identify relationships between the quantities provided and represent the situation in an appropriate mathematical model. These findings indicate a gap between students' expected ability to communicate mathematical ideas and the actual learning conditions. The dominance of teacher-led explanations and routine exercises also limits opportunities for students to discuss and express mathematical ideas.

One approach that can address these challenges is ethnomathematics, which connects mathematical concepts with cultural practices and students' real life experiences (D'Ambrosio (1985); Mairing et al. (2024). Ethnomathematics provides familiar contexts for students to construct mathematical understanding and engage meaningfully with mathematics. The ethnomathematics approach is one of several methods for delivering mathematical content that is relevant to students' everyday lives (Wulantina et al., 2025). Loviana (2026) highlights that ethnomathematics can bridge cultural knowledge and formal mathematics learning, strengthen conceptual understanding, and foster appreciation of local cultural traditions. More specifically, Turmuzi et al. (2024) found that ethnomathematics based learning positively affects students' mathematical communication skills. These findings suggest that cultural contexts can support students in understanding mathematical situations, expressing ideas, using representations, and communicating their reasoning.

Lampung culture offers potential contexts for implementing ethnomathematics because its cultural products and practices contain mathematical ideas. Lampung tapis, for example, can serve as a contextual source for mathematics learning (Suherman & Vidákovich, 2022), while Lampung dance can connect concepts such as geometry, symmetry, patterns, and measurement with local culture (Fatimah et al., 2024). The mathematical concepts used in making cakes

traditional to Lampung are congruence and similarity, division, tube, beam, circle, and rotation (Wulantina et al., 2024). Thus, Lampung culture provides relevant contexts for connecting mathematical concepts with students' cultural experiences.

Student worksheet can translate these contexts into structured learning activities that guide students to explore concepts, solve problems, and communicate their ideas. According to Widodo et al., (2023), student worksheet s can serve as both a primary learning resource and an essential instructional tool in the classroom, while also complementing teachers' learning strategies. Mania et al., (2021) demonstrated that ethnomathematics based student worksheet meet the criteria for validity, practicality, and effectiveness. Dewianti & Jusra, (2023) found that interactive worksheets can support students' mathematical communication skills, while Hidayat et al., (2025) showed that culturally based digital worksheets can provide valid and practical learning resources. These findings indicate that worksheets can function beyond routine exercises by facilitating contextual and active mathematics learning.

However, ethnomathematical contexts and worksheets alone may not provide sufficient opportunities for students to develop mathematical communication through language. Students need activities that encourage them to read mathematical information, listen to explanations, discuss ideas, express reasoning, and write mathematical solutions. Bergeron, (1990) The whole language approach integrates listening, speaking, reading, and writing through meaningful and contextual learning experiences. Dias, (1998) These four language activities are closely related to mathematical communication because students need to read and interpret mathematical information, discuss and express mathematical ideas, and write their reasoning and solutions. Whole language has also been considered relevant to mathematics because it supports meaningful, contextual, and communication-oriented learning. So, reading helps students interpret contextual and mathematical information; listening and speaking help them clarify mathematical ideas; writing helps them organize and externalize reasoning.

Ethnomathematics and whole language therefore have complementary functions: ethnomathematics provides meaningful cultural contexts for mathematics, while whole language provides an integrated process for communicating mathematical ideas. Although previous studies have developed ethnomathematics-based or interactive worksheets, they have primarily focused on conceptual understanding, critical thinking, or general mathematical communication. Several previous studies have developed culturally oriented electronic worksheets with different learning approaches and target outcomes. Syahfitri et al., (2026) developed Ethno-STEM-based e-worksheets integrated with a gamification approach to support

students' critical thinking skills in biology learning. Handayani et al., (2026) developed e-worksheets that integrate Ethno-Modeling and the Tri-N approach (Niteni, Nirokke, and Nambahi) to improve students' mathematical critical thinking by connecting mathematical concepts to the local cultural context of Piyungan. Fikrina et al., (2023) developed MPPj Ethno-STEAM e-worksheet, which integrates ethnocultural contexts, STEAM, and project-based learning to improve students' numeracy literacy and conservation character. These studies demonstrate the potential of culturally oriented worksheets to support various learning outcomes. However, none has addressed the integration of Lampung cultural contexts and ethnomathematics with the whole language approach in a mathematics worksheet. Previous studies have not specifically developed a worksheet that integrates Lampung culture, ethnomathematics, and whole language to facilitate students' mathematical communication. This study addresses this gap by developing a Lampung-culture-based student worksheet that integrates ethnomathematics and whole language into junior high school mathematics learning.

Therefore, this study develops Lampung culture-based student worksheet that integrate ethnomathematics and whole language. The novelty lies in combining Lampung cultural contexts with integrated language activities in a structured worksheet designed to facilitate students' mathematical communication by helping them understand mathematical information, use appropriate representations, explain solution strategies, and communicate mathematical reasoning. The objective of this research is to develop Lampung culture-based student worksheet that integrate ethnomathematics and whole language for students' mathematical communication skills.

## METHODS

This study employed a Research and Development (R&D) design to develop Lampung-culture-based student worksheet that integrate ethnomathematics and the whole language approach to support students' mathematical communication in learning Systems of Linear Equations in Two Variables. The development used an adapted Borg and Gall model with seven stages, from research and information collecting to operational product revision.The preliminary field test involved 15 ninth-grade students aged 14–15 years from one junior high school in Lampung Province. The students were selected purposively in consultation with the mathematics teacher. The main field test involved 51 ninth-grade students aged 14–15 years from two junior high schools in Lampung Province. The schools and participants were selected purposively based on their willingness to participate and the suitability of the learning context

for the study. The participants were regular ninth-grade students with varied levels of mathematical ability and were learning the SPLDV topic.

The preliminary student worksheet was evaluated by four doctoral-level experts: two mathematics education experts and two Lampung culture experts. The validity of the developed student worksheet was assessed by four experts, consisting of two mathematics education experts and two Lampung culture experts. The experts were selected based on their relevant expertise and experience in mathematics education or Lampung cultural studies. The mathematics education experts assessed content, learning objectives, presentation, learning activities, and alignment with mathematical communication competencies. The Lampung culture experts evaluated the accuracy, relevance, authenticity, and representation of Lampung cultural contexts and their integration with ethnomathematical content. Each indicator was rated using a five-point scale: 1 = very inappropriate, 2 = inappropriate, 3 = moderately appropriate, 4 = appropriate, and 5 = very appropriate. The validity score was calculated using the following formula:

$$V = \frac{S}{S_{max}}$$

Where (V) is the validity value, (S) is the total score obtained, and ($S_{max}$) is the maximum possible score. These criteria are used to determine the level of validity of the developed student worksheet, as presented in Table 1 from Arikunto, (2019).

**Table 1**. Level of Validity

| V Value | Category |
|---|---|
| 0,80 < V ≤ 1,00 | Very High |
| 0,60 < V ≤ 0,80 | High |
| 0,40 < V ≤ 0,60 | Moderate |
| 0,20 < V ≤ 0,40 | Low |
| 0,00 <V ≤ 0,20 | Very Low |

The validity category was then used to interpret the results of expert validation. A higher (V) value indicates a higher level of validity of the developed student worksheet. The worksheet was considered to have a very high level of validity when the obtained (V) value was greater than 0.80 and up to 1.00. The resulting category served as the basis for determining whether revisions to the developed worksheet were required. Data were collected through expert validation and student response questionnaires. The instruments included expert validation

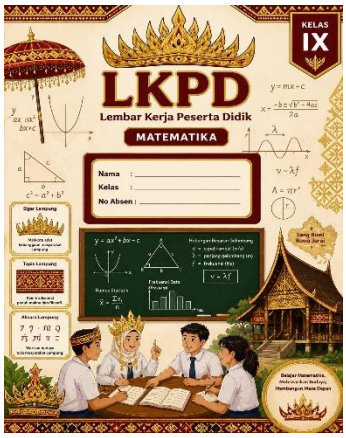
sheets and student response questionnaires. The validation instrument covered content, presentation, learning activities, cultural relevance, and suitability for supporting mathematical communication, and to clarify the product's feasibility.

The development process began with a needs analysis, literature review, and identification of Lampung cultural contexts relevant to Systems Of Linear Equations In Two Variables. The student worksheet was then designed by integrating ethnomathematical contexts with whole language activities. After expert validation, the product was revised, tested in a preliminary field test, revised again, and implemented in the main field test. The final product was refined based on the main field test results.

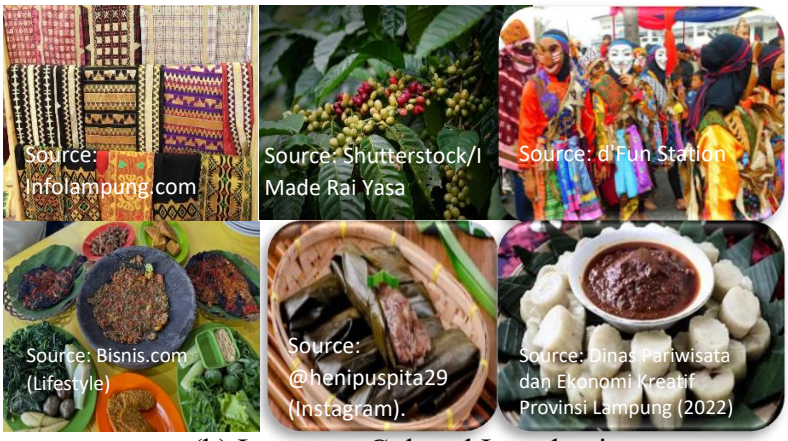
Quantitative data from expert validation and student questionnaires involving 15 student's were analyzed descriptively using percentage scores to determine the validity and practicality of the student worksheet. Students' mathematical communication was addressed through predetermined indicators incorporated into the worksheet activities. These indicators included the use of mathematical symbols and representations, interpretation and explanation of mathematical information, and systematic communication of reasoning and solution strategies. The indicators were used to guide the development of worksheet activities and expert validation rather than to measure students' mathematical communication as an outcome variable. Qualitative data from expert feedback, and student responses were analyzed descriptively to guide product revision and sharpen the student worksheet final value.

## RESULTS AND DISCUSSION

The preliminary study showed that mathematics instruction in several junior high schools in Lampung Province had not been meaningfully integrated with local cultural contexts. Although students had been introduced to Lampung culture, this was generally limited to cultural recognition and not connected to mathematical concepts. Unstructured interviews were conducted with four mathematics teachers from two junior high schools in Lampung. The interviews covered teaching practices, learning resources, the use of student worksheets, and the integration of Lampung culture in mathematics lessons. The data were analyzed descriptively to identify students' learning needs. The findings indicated a need for learning materials that connect mathematics with local culture and support students' mathematical communication. These findings, together with the analysis of existing learning materials, informed the development of the worksheet.



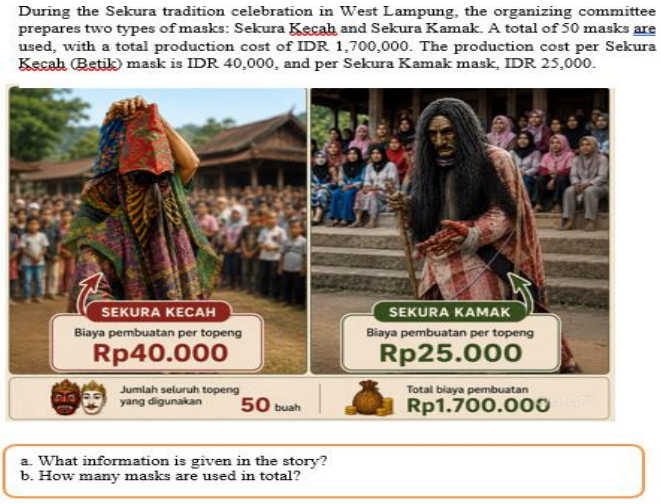

(a) Student Worksheet Cover




(b) Lampung Cultural Introduction

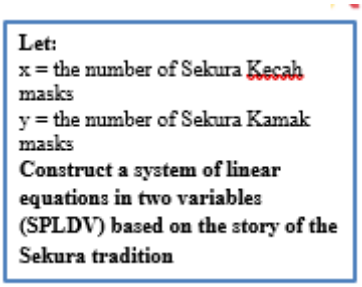


(c) QR Code and Instructional Video

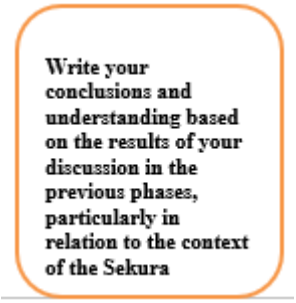



*Source: AI-generated illustration by the authors, 2026*

(d) Collaboration




(e) Exploration




(f) Reflection




*Source: AI-generated illustration by the authors, 2026*

(g) Motivational Activity

**Figure 3.** Design of the Lampung Culture-Based Student Worksheet

Student worksheet was designed as a sequential learning resource that begins with an introduction to Lampung culture. These cultural contexts give students background knowledge before they engage in mathematical activities. Student worksheet then provides QR codes linking to instructional videos to support students' understanding of the learning material. The

worksheet integrates listening, reading, speaking, and writing activities. For listening, students listen to information from instructional videos and their peers' explanations during group discussions, then identify the relevant mathematical information and solution strategies. For reading, students read contextual SPLDV problems and identify the known and asked information. For speaking, students explain their solution strategies and the relationships between the mathematical model and the cultural context. For writing, students formulate the SPLDV model, present systematic solution steps, and write logical conclusions. These activities support mathematical communication through identifying information, using appropriate representations and symbols, explaining mathematical ideas, and presenting logical solutions.

Students then explore information from learning resources beyond printed textbooks to develop their understanding and solution strategies. Finally, students present their findings and conclusions to the class. This sequence connects cultural introduction, collaboration, mathematical exploration, and mathematical communication into a single learning process, as illustrated in Figure 3 that shows the sequential design of the student worksheet, integrating Lampung cultural contexts with the whole language approach. The activities begin with a motivational cultural introduction, followed by instructional videos accessed through QR codes. Students then read contextual narratives, discuss and solve problems collaboratively, explore information from various sources, and write their solutions and conclusions. Finally, they present their findings to the class. This sequence integrates listening, reading, speaking, and writing, connects mathematical learning to Lampung culture, and supports students' mathematical communication skills. Based on these findings, the student worksheet was developed by integrating ethnomathematics and whole language in Systems Of Linear Equations In Two Variables learning. The product incorporated Lampung cultural contexts, including Pesta Sekura, traditional Lampung cakes, kain tapis, seruit, and agricultural products such as coffee and pepper. These contexts were connected to Systems of Linear Equations in Two Variables, including linear equations in two variables and key solution methods. Table 2 presents the main components of the developed student worksheet.

**Table 2**. Components of the Developed Student Worksheet

| Component | Integration in the Student Worksheet |
|---|---|
| Ethnomathematics | Pesta Sekura, traditional Lampung cakes, kain tapis, seruit, coffee, and pepper as contexts for Systems of Linear Equations in Two Variables Variables problems |
| Whole Language | Reading, listening, speaking, and writing |
| Mathematical communication | Grammar skills, discourse comprehension skills, and strategic ability |
| Systems of Linear Equations in Two Variables | Linear equations in two variables, graphical, substitution, elimination, and combined methods |

The integration of ethnomathematics gives students familiar contexts for understanding mathematical situations, as shown in Table 2. This is consistent with Loviana et al., (2026), who found that ethnomathematics can bridge cultural knowledge and formal mathematics learning while strengthening students' conceptual understanding and appreciation of local cultural traditions. Turmuzi et al., (2024) also reported a positive contribution of ethnomathematics-based learning to students' mathematical communication skills. Therefore, using Lampung cultural contexts in the student worksheet provides meaningful situations that help students understand and communicate mathematical ideas.

The student worksheet was further designed using the whole language approach through reading, listening, speaking, and writing activities. These four activities are closely related to mathematical communication because students need to read and interpret mathematical information, discuss and express mathematical ideas, and write their reasoning and solutions. Thus, whole language complements ethnomathematics by giving students opportunities to communicate mathematical ideas rather than only perform mathematical procedures. According Daniels et al., (1999), whole Language not only supports students' reading and writing skills but also encourages them to become more active, independent, and meaningful users of language. Rather than learning language subskills separately, students develop and apply them in an integrated, meaningful learning context. Two mathematics education experts assessed the quality of the developed student worksheet. Table 3 presents the validation results.

**Table 3.** Validation Results by Mathematics Education Experts

| Validation Aspect | Validation Index | Category |
|---|---|---|
| Student Worksheet suitability | 0.90 | Very High |
| Clarity of student worksheet presentation | 0.90 | Very High |
| Activities and learning outcomes | 0.95 | Very High |
| Average | 0.916 | Very High |

The average validity index of 0.916 indicates that the developed student worksheet was categorized as very high in terms of validity and was considered highly suitable for use. The highest index was obtained for activities and learning outcomes, indicating that the activities were considered appropriate for supporting the intended learning objectives as shown in Table 3. The validators suggested several improvements, which were incorporated into the revised student worksheet. The cultural suitability of the student worksheet was assessed by two experts in Lampung culture. The results are presented in Table 4.

**Table 4.** Validation Results by Lampung Culture Experts

| Validation Aspect | Validation Index | Category |
|---|---|---|
| Integration of Lampung culture | 0.867 | Very High |
| Visual quality and cultural representation | 0.96 | Very High |
| Suitability of cultural context in learning | 0.90 | Very High |
| Average | 0.908 | Very High |

The average validity index of 0.908 indicates that the cultural aspects of the student worksheet were categorized as very high in terms of validity and were considered highly suitable for use, as shown in Table 4. The highest score was obtained for visual quality and cultural representation. The cultural experts recommended strengthening the connection between Lampung culture and Systems of Linear Equations in Two Variables problems, and these recommendations were implemented by revising the student worksheet. The validation process also provided suggestions for improving the student worksheet in terms of mathematical presentation, cultural integration, and learning activities. Suggestions from mathematics education and Lampung culture experts were incorporated into revisions to improve the student worksheet. The main suggestions and revisions are presented in Table 5.

**Table 5.** Suggestions and Revisions of the Developed Student Worksheet

| Validator | Aspect | Suggestions | Revision |
|---|---|---|---|
| Mathematics education experts | Student worksheet suitability | Ensure that the student worksheet content and activities align with the learning objectives and | The content and learning activities were revised to ensure alignment with the learning objectives and |

| Validator | Aspect | Suggestions | Revision |
|---|---|---|---|
| | | Systems of Linear Equations in Two Variables competencies. | Systems of Linear Equations in Two Variables competencies. |
| Mathematics education experts | Presentation clarity | Simplify the narratives and clarify the instructions. | The narratives and instructions were revised using simpler and clearer language. |
| Mathematics education experts | Learning activities | Add motivational statements, learning videos, and discussion activities. | Motivational statements, video links/QR codes, and discussion activities were added. |
| Lampung culture experts | Cultural integration | Strengthen the connection between Lampung culture and Systems of Linear Equations in Two Variables problems. | More Lampung cultural contexts were integrated into Systems of Linear Equations in Two Variables problems and learning activities. |
| Lampung culture experts | Cultural representation | Improve the authenticity and quality of cultural illustrations. | Cultural illustrations, Lampung motifs, image quality, and layout were improved. |

Table 5 shows that the validators' suggestions mainly focused on strengthening cultural representation, improving the clarity of the student worksheet, and increasing student engagement. The revisions strengthened the alignment between Lampung culture, whole language activities, and mathematical communication in the developed student worksheet.

The three indicators of mathematical communication were explicitly incorporated into the learning activities. Grammar skills were developed through activities requiring students to use mathematical symbols, notation, operations, and terminology appropriately. Discourse comprehension skills were developed through activities in which students read information related to Lampung culture and mathematics, identified what they knew and what they needed to ask, and explained the information in their own words. Strategic ability was developed through activities requiring students to determine solution strategies, construct Systems of Linear Equations in Two Variables models, organize solution steps, explain their reasoning, and draw conclusions.

The integration of these indicators is evident in the relationships among the cultural contexts, whole language activities, and Systems of Linear Equations in Two Variables tasks.

Students were asked not only to solve mathematical problems but also to read, listen, discuss, explain, represent, and write about their mathematical reasoning. This structure distinguishes the student worksheet from worksheets that primarily provide routine exercises. Mania et al., (2021) showed that ethnomathematics based student worksheet can support mathematics learning through valid and practical learning materials, while Dewianti & Jusra, (2023) demonstrated that interactive worksheets can support mathematical communication skills. The present student worksheet extends these findings by integrating ethnomathematical contexts with Whole language activities and explicitly organizing learning tasks according to mathematical communication indicators.

Overall, the validation results and product revisions indicate that the developed student worksheet is appropriate in terms of mathematical content, cultural integration, presentation, and learning activities. More importantly, the product provides a structured, distinctive context for connecting Lampung culture with Systems of Linear Equations in Two Variables and facilitating students' mathematical communication. The novelty of this development lies in the integration of Lampung ethnomathematics and whole language into a worksheet specifically designed around mathematical communication indicators. To our knowledge, few studies have explicitly integrated Lampung ethnomathematical contexts and whole language activities within an student worksheet structured around mathematical communication indicators. The distinctive contribution of this study is the integration of Lampung ethnomathematical contexts and whole language activities in an student worksheet structured around mathematical communication indicators.

The practicality of the developed student worksheet was assessed using a questionnaire administered to 15 junior high school students during preliminary field testing. The questionnaire contained 22 statements across five aspects: Lampung culture and ethnomathematics; mathematical learning and communication; whole language and collaboration; readability and presentation; and multimedia and learning motivation. The practicality index for each aspect was calculated to determine the student worksheet s usability. The results are presented in Table 6.

**Table 6**. Practicality Index of the Lampung Culture-Based Student worksheet

| No. | Aspect | Item Numbers | Practicality Index | Category |
|---|---|---|---|---|
| 1 | Lampung Culture and Ethnomathematics | 1–3 | 0,894 | Practical |
| 2 | Mathematical Learning and Communication | 4–12 | 0,885 | Practical |
| 3 | Whole Language and Collaboration | 13–17 | 0,896 | Practical |
| 4 | Readability and Presentation | 18–20 | 0,861 | Practical |
| 5 | Multimedia and Learning Motivation | 21–22 | 0,9 | Practical |
| | Average | | 0,887 | Practical |

As shown in Table 6, all five aspects were categorized as usable based on the responses of the 15 students. The student worksheet had an average practicality index of 0.887, which is categorized as practical. All assessed aspects were also classified as practical. The highest index was found in Multimedia and Learning Motivation (0.900), and the lowest in Readability and Presentation (0.861). These results indicate that the student worksheet is generally easy to use, well-presented, and supportive of the learning process and students' mathematical communication. Overall, the results indicate that the student worksheet was usable in terms of cultural integration, mathematical learning and communication, whole language activities, readability and presentation, and multimedia and learning motivation.

Following preliminary field testing, the developed student worksheet was revised based on student responses and observations from the limited trial. Although the overall practicality index was 0.887 and the student worksheet was categorized as practical, several aspects were refined to improve clarity, consistency, and usability. The revision focused on the presentation of mathematical activities, the clarity of instructions, the integration of Lampung cultural contexts, and the sequence of whole language activities. Several questions and supporting illustrations were also adjusted to ensure that the learning activities suited students' abilities and facilitated mathematical communication. These revisions produced an improved version of the student worksheet that was ready for implementation in on the main field test. The practicality results of the developed student worksheet are presented in Table 7.

**Table 7**. Practicality of the Developed student worksheet on the Main Field Test

| No. | Aspect | Item Numbers | Practicality Index | Category |
|---|---|---|---|---|
| 1 | Lampung Culture and Ethnomathematics | 1–3 | 0,871 | Practical |
| 2 | Mathematical Learning and Communication | 4–12 | 0,802 | Practical |
| 3 | Whole Language and Collaboration | 13–17 | 0,852 | Practical |
| 4 | Readability and Presentation | 18–20 | 0,848 | Practical |
| 5 | Multimedia and Learning Motivation | 21–22 | 0,852 | Practical |
| | Average | | 0,845 | Practical |

The preliminary and main field tests involved students from different schools but at the same grade level. The preliminary field test involved 15 ninth-grade students aged 14–15 years from one junior high school in Lampung Province, whereas the main field test involved 51 ninth-grade students aged 14–15 years from two different junior high schools in Lampung Province. Thus, the participants in both stages had comparable grade levels and age ranges, although the school contexts differed. The preliminary field test was conducted to identify initial issues and gather feedback to revise the student worksheet, while the main field test was conducted to assess its practicality in broader school contexts. Therefore, differences in practicality scores between the two stages should be interpreted in light of the different purposes and school contexts of the field tests. Overall, the student worksheet s were practical because all evaluated criteria exceeded the prescribed standard. The highest practicality index was achieved in Lampung Culture and Ethnomathematics (0.871), while the lowest was found in the Mathematical Learning and Communication aspect (0.802). These results confirm that the worksheets are practical in cultural integration, mathematical learning and communication, Whole Language and collaboration, readability and presentation, and multimedia and learning motivation.

Ethnomathematics provides the cultural context, allowing students to understand mathematical concepts through familiar Lampung cultural practices (D'Ambrosio, 1985; Loviana, et all, 2026). Whole language provides the communication process through reading, listening, speaking, and writing, enabling students to interpret information, discuss ideas, use mathematical representations, and explain their reasoning (Amelia, 2024). According to

Schwarzer, (2001), whole language is a philosophy of teaching and learning that can be applied across diverse educational contexts, age groups, and cultural and linguistic backgrounds while maintaining its fundamental principles of learning. In conclusion, ethnomathematics provides a meaningful cultural context, while whole language facilitates integrated communication, making their combination relevant for supporting students' mathematical understanding and communication skills.

Student worksheet organizes these processes into a sequence of Lampung culture, meaningful mathematical context, reading and interpreting, discussion, mathematical representation, explanation, and written reasoning. This integration is consistent with Turmuzi et al., (2024), who found that ethnomathematics-based learning positively contributed to students' mathematical communication skills. Thus, culture serves as the context, whole language as the communication process, and the student worksheet as the learning structure for supporting mathematical communication skills.

The developed student worksheet integrates Lampung cultural contexts, whole language activities, Systems of Linear Equations in Two Variables concepts, and mathematical communication indicators. Lampung culture provides meaningful contexts for presenting Systems of Linear Equations in Two Variables problems, enabling students to connect mathematical concepts with familiar cultural experiences. Whole language is implemented through listening to learning videos, reading contextual problems, discussing solutions with peers, and writing mathematical ideas and conclusions.

The developed student worksheet achieved a very high level of validity, showing its appropriateness in mathematical content, the Lampung cultural context, learning activities, and support for mathematical communication. This finding is consistent with previous studies by Handayani et al., (2026); Fikrina et al., (2023), which showed that culturally integrated worksheets can support various learning outcomes. This study further highlights the integration of Lampung culture, ethnomathematics, and whole language to facilitate mathematical communication.

The worksheet was practical to implement. However, some exploration activities were less than optimal due to limited access to mobile phones and digital resources. This limitation suggests that culturally and digitally integrated worksheets should account for students' access to technology and differences across school contexts. Previous studies have demonstrated the potential of culturally based worksheets to support students' learning. Iskandar et al., (2022) developed West Java batik-themed worksheets and found that ethnomathematics-based

materials improved students' mathematics learning outcomes. Anawati et al., (2024) developed ethnomathematics-based mathematics worksheets for fourth-grade students on perimeter and plane geometry and reported that they were of good quality, as indicated by expert validation and student responses. Syahfitri et al., (2026) further showed that Ethno-STEM-based e-worksheets, integrated with gamification, effectively improved students' critical thinking skills in biology. These findings indicate that cultural contexts can be incorporated into worksheets to create meaningful learning and support students' learning outcomes. However, previous studies focused on mathematics learning outcomes, general worksheet quality, or critical thinking, and did not specifically integrate ethnomathematics and whole language into a worksheet designed around mathematical communication indicators. Therefore, the present study extends previous research by developing a Lampung-culture-based student worksheet that integrates ethnomathematics and whole language to facilitate students' mathematical communication skills in learning Systems of Linear Equations in Two Variables and to thereby offering a culturally responsive learning resource for Systems of Linear Equations in Two Variables.

## CONCLUSION

This study developed a Lampung culture-based student worksheet that integrates ethnomathematics and the whole-language approach to support students' mathematical communication skills. The findings indicate that the student worksheet provides a coherent sequence of learning activities involving listening, reading, speaking, and writing through culturally contextualized mathematical tasks, collaborative discussions, exploration, and presentation. Sukmayasa & Sudiana, (2023) students are encouraged to strengthen their motivation to learn and productive communication skills through an integrated whole language approach to Indonesian language learning.

Its main contribution is integrating Lampung cultural contexts and whole language into a single learning resource to facilitate meaningful mathematical communication. Future research should examine the effectiveness and retention of the developed worksheet using validated mathematical communication tests, appropriate comparison groups, implementation-fidelity measures, and delayed assessments. These measures would provide stronger evidence of their effects on students' mathematical communication skills and the retention of learning outcomes. The developed student worksheet is expected to serve as a practical resource for mathematics

teachers to implement culturally responsive and language-integrated learning while strengthening students' mathematical communication skills.

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