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SPADE ETHNOMATHEMATICS: DEVELOPING STUDENT WORKSHEETS THROUGH EGRANG BATOK KELAPA GAMES TO ENHANCE LENGTH MEASUREMENT UNDERSTANDING IN SECOND GRADE

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Abstract. Elementary mathematics education frequently prioritizes procedural memorization, often neglecting to forge meaningful connections between mathematical concepts and students' everyday realities. This pedagogical approach frequently culminates in diminished conceptual understanding among learners. Such shortcomings are conspicuously apparent in the domain of length measurement, a topic that inherently demands hands-on, experiential learning opportunities to foster genuine comprehension. Scholarly literature underscores that weaving local cultural elements into mathematics instruction markedly bolsters student engagement and deepens their grasp of abstract ideas. The Egrang Batok Kelapa game, embodying a pertinent facet of indigenous wisdom, offers an authentic framework for imparting length measurement principles through non-standard units, such as footsteps, thereby bridging classroom theory with cultural relevance. This investigation devised an ethnomathematics-infused Student Worksheet employing the SPADE model—encompassing Singing, Playing, Analyzing, Discussing, and Evaluating—while integrating the Egrang Batok Kelapa game as a contextual learning tool. The primary aim was to elevate second-grade students' proficiency in comprehending non-standard length measurement via immersive, enjoyable, and culturally embedded activities. Adopting a Design and Development methodology aligned with the ADDIE model, the study utilized expert validation sheets and restricted trial assessments with students as key instruments. Outcomes revealed robust validity, with an 88.3% endorsement from subject matter and media specialists, alongside exceptional feasibility evidenced by a 93.3% approval in student trials. Ultimately, the SPADE model ethnomathematics-based worksheet demonstrated efficacy in augmenting elementary students' mastery of non-standard length measurement concepts, promoting a more holistic and culturally attuned educational experience.

Keywords: student worksheets, ethnomathematics, SPADE model, *egrang batok kelapa*, length measurement.

INTRODUCTION

Mathematics is a discipline that equips students with knowledge and skills, and fosters logical, critical, and analytical thinking so that students can think progressively to understand various concepts, principles, and solutions in solving mathematical problems(Mufliva et al., 2024). Jaya in (Ramadanti et al., 2023) states that mathematics is a science that emphasizes the way of thinking rather than just the results. When faced with mathematical problems, students will try to find solutions

through stages of thinking Mathematics. Therefore, mathematics is an important subject that elementary school students must learn to develop critical, systematic, and creative thinking skills as preparation for navigating constantly changing conditions (Witono & Hadi, 2025) Measurement is one of the mathematics subjects taught to elementary school students.

Based on interviews conducted by researchers, it was found that second-grade students did not yet understand the concept of measuring length using non-standard units. Student find it difficult to distinguish between the use of standard and non-standard units of length measurement. This is because the learning activities are not innovative and enjoyable enough; students only listen to the teacher's explanations in class. Similar research was also conducted by Azhari who found that students had difficulty understanding measurement material using non-standard units, which resulted in below-average learning outcomes. This problem needs to be addressed and followed up on because measurement is an integral part of everyday human life. Length measurement activities are often carried out in daily activities, such as measuring the length of objects and measuring travel distances when traveling. (Shabrina et al., 2023) argue that it is important for students to have an understanding of the concept of length measurement because this concept is used by students in their daily lives.

A solution that can be used to overcome this problem is to connect mathematics learning with local Indonesian culture through an ethnomathematics approach. Lidzinillah (Muhammad, 2023) ethnomathematics is strongly connected to how community groups think mathematically in relation to their cultural context, and it can be incorporated into educational settings. Rahmawati (Hasanah et al., 2024) states that ethnomathematics is mathematics practiced by various cultural groups, such as rural communities, workers, children, and indigenous peoples. Meanwhile, Zhang & Zhang (Mei et al., 2020) define ethnomathematics as the study examining how mathematics relates to the social and cultural backdrop within which it is practiced, distributed, and developed in different cultural systems. According to the definitions provided, ethnomathematics is essentially an instructional approach that establishes

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connections between mathematics and local cultural elements. One local culture that can be integrated into mathematics learning is traditional games. The results of research conducted by (Naza et al., 2025) show that traditional games in Indonesia not only contain cultural values but can also be used as a medium for contextual and enjoyable mathematics learning for students.

Several previous studies have used traditional games as a tool for mathematical instruction. In a study by (Hartono et al., n.d.) the traditional game of engklek was applied in mathematics learning, and it was concluded that there were mathematical elements in it. Research by (Mei et al., 2020) showed that there are mathematical concepts in the traditional game of marbles, namely the concepts of distance, addition, and flat shapes. Research by (Sabon et al., 2021) showed that there are mathematical element in the traditional game of kebetuk, namely the concepts of arithmetic operations. Findings from (Safitri et al., 2024) shows that the application of the traditional game of hopscotch through an ethnomathematics approach has an impacts the educational results of fifth-grade learners.

Length measurement has long been practiced by communities. In the past, people measured length using parts of their bodies, such as their palms, forearms, arms, and footsteps. One traditional game that can be integrated into length measurement material is “Egrang Batok Kelapa” (Coconut Shell Stilts). Through the coconut shell stilts game, students can calculate length using non-standard units of length in the form of footsteps. Therefore, this study will utilize the traditional coconut shell stilts game as a learning medium for length measurement using non-standard units.

In the application of ethnomathematics learning, the SPADE learning model is analyzed to be able to combine mathematics learning with local culture, especially regional games, where there are new experiences that are expected to create learning that is much easier for students to understand and interpret. According to research conducted by Permadi et al. (2021), the SPADE learning model is a new learning model in the field of education, initiated by Dr. Nur’aeni et al. (2020), the SPADE learning model can be integrated into five stages of learning. The stages of the

learning process are contained in the name of the SPADE model itself, namely singing (singing songs adapted to the learning material), playing (playing coconut shell stilts), analyzing (analyzing certain units of measurement), discussing (discussing the results of the analysis), and evaluating (evaluating the results of the analysis). The SPADE learning model is a solution for preserving traditional games by incorporating learning into them (Nur'aeni et al., 2020). Thus, the SPADE learning model can encourage collaboration and interaction among students and provide opportunities for students to learn from each other through discussions, group work, and other activities.

The implementation of the SPADE learning model can be optimized by using teaching tools that encourage student activity and independence in the learning process. One such teaching tool that can be used is the Student Worksheet. The Student Worksheet plays a role as part of the learning tools that help educators optimize the role of students in learning (Mufliva & Iriawan, 2022). According to (Permadi et al., 2021), student worksheet are materials featuring exercises and activities that support the development of students' competencies in learning. In addition, student worksheets in the teaching-learning process has the potential to generate new interests and aspirations, inspire learners, promote active participation, and produce psychological impacts on students (Fatimah & Wiratama, 2024). Incorporating student worksheets within the SPADE learning model serves as a valuable instrument for facilitating the attainment of educational goals. There are several stages in the SPADE model, such as the analysis stage, where students need to be provided with activity sheets to guide their observations of the playground. Then, in the discussion stage, students write down the results of their discussions from several questions contained in the student worksheet based on their observations in the game arena. Then, in the evaluation stage, any errors are corrected, and the use of the student worksheet can be a reference for the extent of students' understanding of the concepts in the learning process.

Applying various interesting activities combined with regional games such as coconut shell stilts can provide students with the opportunity to understand concepts in length measurement such as distance accumulation and origin (zero point). Coconut shells

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are not only objects for games, but also potential learning tools for students to understand measurement concepts in a real way. It also helps students build an understanding of standard length measurement tools such as rulers after having experience playing egrang batok kelapa. This is included in activities where students observe the results of measuring the distance traveled in the egrang batok kelapa game, which uses non-standard units.

Based on the above description, the researcher was interested in conducting research and development of student worksheets based on ethnomathematics using the SPADE model, which offers learning through various activities that are fun yet meaningful and help students discover measurement concepts through concrete objects around them, namely by using coconut shell stilts.

METHODOLOGY

This study uses the Design and Development (D&D) research method. Richey & Klein (2014) state that D&D is a systematic study of the design, development, and evaluation processes to provide an empirical basis for the production of instructional and non-instructional tools or products, as well as new models or improvements. Specifically, this method aims to develop new innovations in the field of education, where developers can empirically identivy needs and challenges in order to create targeted products (Helsa Qaira Sukmarani et al., 2025). The model used is the ADDIE model, comprising five sequential phases, namely analysis, design, development, implementation, and evaluation (Harwiyati et al., 2025). The research stages can be seen in the ADDIE model chart (Hardi et al., 2023) in Figure 1.

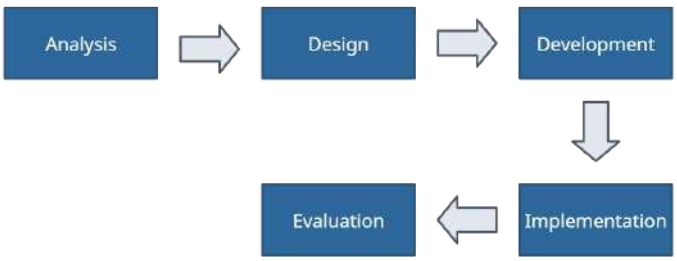

Figure 1. Picture of ADDIE model diagram (Hardi et al., 2023)

The analysis stage involved reviewing literature and the Merdeka Curriculum Phase A learning outcomes on measurement as references for worksheet development. The design stage covered content outlining, material selection, and the creation of covers, illustrations, and questions. In the third stage, development, the researchers began developing the worksheets with the help of several digital applications. After development was complete, the product was validated by subject matter experts, media design experts, and students. Validation was carried out by distributing questionnaires to subject matter experts, media experts, and a limited number of students. The questionnaire for subject matter experts evaluated three key dimensions: the appropriateness of content, the effectiveness of presentation, and the suitability of language (Hafidzah et al., 2021). The media expert questionnaire covered three aspects, namely visual aspects, content aspects, and other aspects, in accordance with references from Fatayan et al. (2022). The student response questionnaire consisted of three aspects, namely ease of use, motivation, attractiveness, and usefulness (Sholihah et al., 2024). The next stage involved testing or implementation with six second-grade students at an elementary school in Bandung. This activity was carried out by demonstrating student worksheets, completing evaluation questions, and filling out student response questionnaires. The final stage, evaluation, involved improving the product based on feedback provided by validators. The criteria for the feasibility of the student worksheet were developed using a Likert scale according to Arikunto (Puspita, 2021)as presented in Table 1.

Table 1. Learner Worksheet Feasibility Criteria and Percentage Range

Score in percent (%)	Categories
81-100	Very Fiesible
61-80	Feasible
41-60	Enough
21-40	Lacking
<21	Very Lacking

RESULTS AND DISCUSSION

The stages carried out in accordance with the ADDIE model applied are 1) the

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analysis stage, 2) the design stage, 3) the development stage, 4) the implementation stage, and 5) the evaluation stage.

In the first stage namely analysis, according to the interview findings obtained by researchers, it was found that second-grade students did not fully understand the material on measuring length using non-standard units. The reasons for this problem were that the learning process was not innovative or enjoyable, and students did not experience direct learning because they often listened to the teacher's explanations. In addition, students found it difficult to distinguish between the use of standard and non-standard measuring instruments. Based on the analysis results, the researcher felt the need for a Student Worksheet aimed at guiding students' understanding of the concept of length measurement. Teachers can use student worksheets to make students active and communicative during the learning process Septian et al. in (Chandra & Hidayati, 2023). Considering that second-grade elementary students remain in the concrete operational phase, they have developed sufficient maturity to apply logical reasoning and operations, but only when working with tangible objects that are physically present (Juwantara, 2019). Learning will be more effective if it is packaged in a form that is fun and close to their world. Contextual learning encourages teachers and students to be able to use their surroundings and daily activities as the main material for learning (Fauzi et al., 2023). One approach that suits the characteristics of students of this age is through games. Wiranti in (Dewi et al., 2023) states that her research shows that game-based learning can develop other aspects of development such as cognitive, language, social, and emotional aspects. The games chosen should be those that are familiar and ingrained in the lives of students, namely traditional games. Traditional games are not only fun, but also rich in local cultural values that are close to the daily experiences of students. Siregar and Lestari in (Widyastuti et al., 2020) state that traditional games are entertaining activities that use simple tools and no tools, which are inherited from generation to generation. The second stage is design. In this stage, the design related to the creation of mathematics student worksheets with length measurement material is carried out. The design developed by the researcher includes six main components of the student worksheet,

namely: title, learning instructions, learning objectives or main material, supporting information, tasks or work steps, and assessment. The six components in the student worksheet are arranged based on the ethnomathematics approach and syntax of the SPADE learning model, namely: singing, playing, analyzing, discussing, and evaluating.

The third stage is development, in which researchers adjust the results of the analysis and develop a product in the form of a Student Worksheet using the Canva application. The student worksheet is compiled based on ethnomathematics using the SPADE model, so that SPADE syntax (Singing, Playing, Analyzing, Discussing, and Evaluating) is used in its compilation. In addition, this student worksheet also applies an integrated ethnomathematics approach through the game “egrang batok kelapa” as a contextual medium to improve the understanding of second-grade elementary school students of non-standard measurement concepts. The developed product was then validated by subject matter experts and media design experts.

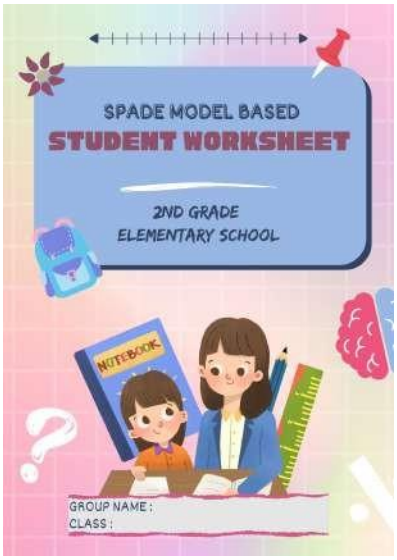

Figure 1. Cover design

The image above shows several initial components of a developed student worksheet. The first part contains a cover design that includes the student's identity and is

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designed to attract the student's attention. Finally, there are usage instructions that provide step-by-step guidance to students on how to use the student worksheet effectively in the learning process.

Figure 2. Learning outcomes and objectives

The second image contains the learning outcomes and objectives that students must achieve through ethnomathematics-based worksheets using the SPADE model through the coconut shell stilts game.

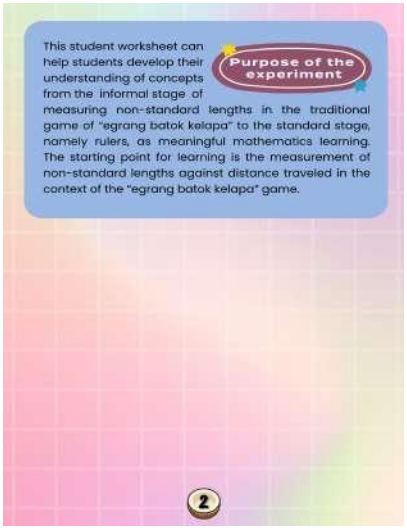

Figure 3. Experiment objectives

The third section outlines the objectives of the activities to be carried out by the students. The objective of these activities is to build students' understanding of non-standard measurement concepts by utilizing the game egrang batok kelapa as a learning medium.

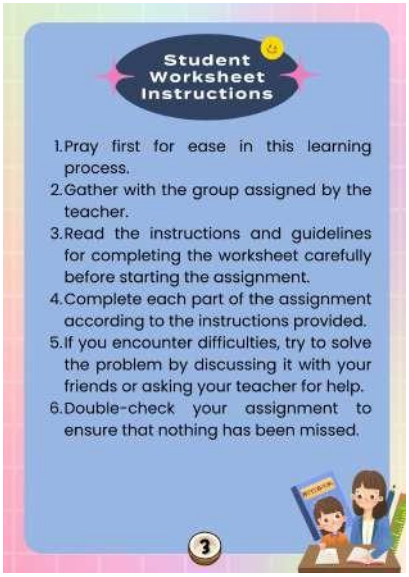

Figure 4. Instructions for use

The fourth image shows the student worksheet instructions that provide students with step-by-step guidance on how to use the worksheets effectively in the learning

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process. Starting from praying before activities to things to consider when using student worksheets.

Figure 5. Introduction to the material

Figure 5 presents an introduction for students aimed at understanding the material to be studied in mathematics lessons and subsequent activities. The figure contains provoking questions and explanations about the coconut shell stilts game and its relevance to the continuity of learning.

Figure 6. Design of singing activities

The image above shows the song that will be sung by the students. This activity is part of the first SPADE model syntax, namely singing. This activity aims to attract interest and create a fun learning atmosphere. The songs used are selected based on their relevance to the learning material.

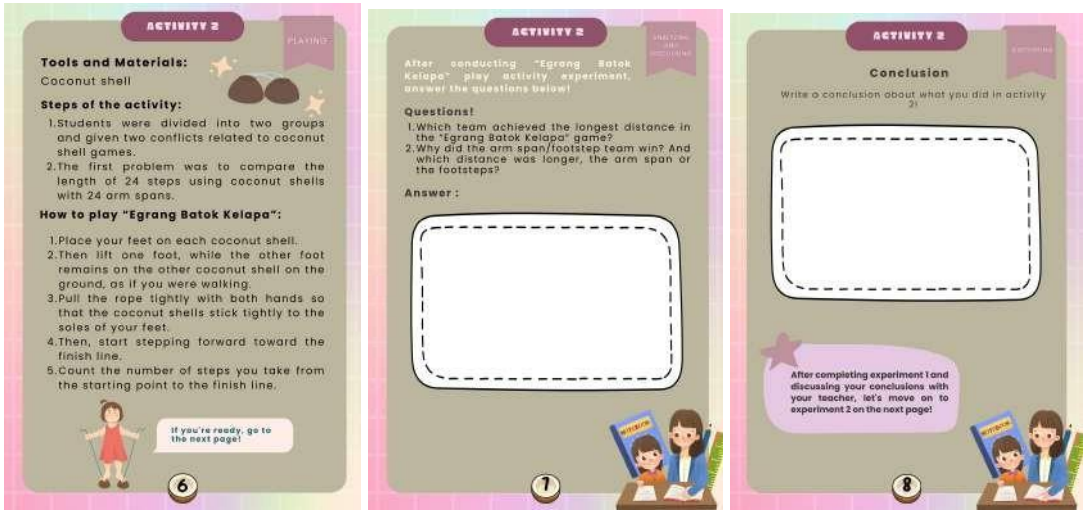

Figure 7. Activity design for analysis and discussion

The picture above shows the game that the students will play. In this section, students will be told the steps to play the coconut shell stilts game. Then, on the next page, there are questions aimed at sparking students' understanding of the relationship between the length of their stride and how fast they can reach the finish line.

Figure 8. Initial design of non-standard measurement experiments.

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In the initial design of activities that apply SPADE syntax, students will conduct non-standard measurement experiments after previously using regional games. Now, measurement activities use books and pencils to measure the same table length, but using the books they have (the length of the book depends on each individual). Next, each group will discuss with their members to answer questions after they have conducted measurement experiments and written down their conclusions.

Figure 9. Initial observation design based on standard measurement principles

In the initial design of this activity, students will carry out the next activity, namely "Observation 1." Once students begin to understand the concept of non-standard measurement, they will then be guided to calculate using standard measuring instruments such as rulers. To demonstrate their understanding of using standard measuring tools, at the end of the activity each group will measure objects around them and present their findings in a student worksheet. This activity aims to guide students in performing standard measurements gradually by measuring objects around them.

Figure 10. Evaluation section design

The image above shows an evaluation activity, in which students are asked to answer questions. This activity is designed to assess the extent to which students understand the concept of length measurement, starting from measurement using non-standard units to measurement using standard units. Students' analytical skills will be assessed in this section.

Based on the development of student worksheets through the coconut shell stilts game, which was created to improve students' understanding of measurement material, a series of comprehensive evaluation processes have been carried out. This process involved subject matter experts, media experts, and limited testing with students. At this stage, the evaluation results show that the student worksheets using coconut shell stilts based on spades are considered suitable for use. In other words, in terms of media appearance, content, and application in learning activities, all aspects have met the criteria required to support active and enjoyable learning. The summary of the validation results by experts and the results of limited testing on students are presented in more detail in Table 1 below, as a basis for assessing the feasibility and effectiveness of the developed product.

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Table 1. Results of Material and Media Validation, as well as Limited Testing of Students

Validation Results	Percentage	Category
Subject Matter Expert	91,6 %	Very feasible
Media Expert	88,3 %	Very feasible
Limited Testing of Students	93,3 %	Very feasible

Based on the results in Table 2, the evaluation of the material validator includes three dimensions of assessment, namely the content feasibility dimension, the presentation feasibility dimension, and the linguistic feasibility dimension the teaching material validation process needs to cover aspects of content, language, and presentation to ensure that the learning products meet the expected quality standards (Fhardhila et al., 2025). The results of the material validator's evaluation show that the average assessment percentage reached 91.6%, indicating that this student worksheet is very feasible for implementation in learning. In terms of content feasibility, the highest percentage obtained was 95%. This figure shows that the material contained in the student worksheet covers the completeness, breadth, and depth of the material adequately. Each concept and definition has been compiled accurately and precisely. The illustrations and images presented are not merely visual elements, but have a pedagogical function that supports students' understanding of the learning material. For the second aspect, the feasibility of presentation obtained a percentage of 90%. This result indicates that the presentation structure in the ethnomathematics-based student worksheet with the SPADE model has been designed systematically with a coherent and consistent flow. Students are guided to actively participate through five sequential stages: Singing, Playing, Analyzing, Discussing, and Evaluation. The last aspect, linguistic feasibility, obtained a percentage of 90%. The language used in the SPADE-based student worksheet is communicative and interactive, and is adapted to the cognitive and linguistic development level of elementary school students.

Table 2. Material Validation Results

Validation Results	Percentage	Category
Content Feasibility Aspects	95 %	Very feasible
Presentation Feasibility Aspects	90 %	Very feasible
Language Feasibility Aspects	90 %	Very feasible

The validation results from the student worksheet design experts covered three main aspects, namely visual, content, and other aspects (Indriyanti, 2017). Based on Table 3, the student worksheet obtained an average feasibility of 88.3% and was categorized as very feasible for use in elementary school learning. In terms of visual aspects, the student worksheet scored 95%, indicating an attractive, creative, and easy-to-understand display for students. The illustrations, colors, and layout are proportionate, while the font type and size are chosen to be comfortable to read and attract students' attention. In terms of content, the score was 90%, indicating that the material was in line with the learning indicators and objectives. The material is presented in a coherent and systematic manner, using simple and communicative language, which helps students understand the concepts easily. Meanwhile, other aspects received a score of 85%, which includes the suitability of the material and learning objectives, as well as the effectiveness of the media in supporting teaching and learning activities. This student worksheet is considered capable of creating interactive and enjoyable learning. Overall, this ethnomathematics-based student worksheet using the SPADE model through the coconut shell stilts game is considered very suitable for use, as it is not only visually appealing but also effective and relevant in supporting students' understanding of the material in elementary school.

Table 3. Media Expert Review Results

Validation Results	Percentage	Category
Visual Aspects	90 %	Very feasible
Content Aspects	90 %	Very feasible
Other aspects	85 %	Very feasible

The fourth stage is implementation. At this stage, the student worksheet product that has been validated through subject matter expert testing and media design expert testing is then given to two groups of students, each consisting of three people, for limited testing. During the trial, the practicality and effectiveness of the product will be assessed. Practicality will be assessed based on the students' responses.

Table 4 shows the results of a limited trial that showed a very positive response with

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an average score of 93.3% (well deserved), which illustrates that the student worksheet successfully met the needs of students and could be implemented. In terms of ease of use, a percentage of 95% was obtained with a very feasible category. Students found the student worksheet very easy to use without causing confusion. They were able to understand the instructions and operate the student worksheet independently without intensive guidance. This student worksheet helped students understand the material presented, both in the use of the student worksheet and the use of coconut shell stilts as teaching aids.

The aspects of motivation and attractiveness also received a score of 95% in the “well deserved" category. The visual design, use of coconut shells, and presentation of content successfully attracted the attention and maintained the focus of the students. Interest in the student worksheet with the coconut shell stilts game motivated students to learn about measuring length and fostered their curiosity. The combination of the student worksheet with concrete teaching aids successfully created an interesting and meaningful learning experience.

The usefulness aspect received a score of 90%, which is considered very good. Students felt the real benefits of this student worksheet in understanding the concept of length measurement more concretely. Although some students regretted that not all of them had the opportunity to try it directly, the coconut shell stilts game still made working on the student worksheet more helpful and increased their enthusiasm for learning. This media also made it easier for students to remember the material because of its interesting and contextual presentation.

Overall, all three aspects showed very satisfactory results with an average score above 90%. This proves that the teaching tools developed meet technical standards and are well received by students. This positive response is a strong indicator that ethnomathematics-based student worksheets using the SPADE model through coconut shell stilts games are worthy of wider implementation as an effective alternative in teaching length measurement.

Table 4. Results of Limited Testing on Students

Validation Results	Percentage	Category
Ease of Use	95 %	Very feasible
Motivation and Attractiveness	95 %	Very feasible
Usefulness	90 %	Very feasible

The final stage is the evaluation stage, which involves evaluating all stages of this research. From this evaluation stage, a final research product is produced in the form of a student worksheet on length measurement based on expert advice and the results of expert testing of the material. This stage also shows that the student worksheet on length measurement developed by the researcher is suitable for use.

CONCLUSION

Based on the research conducted, the ethnomathematics-based student worksheet using the SPADE model obtained results in the very feasible category based on the material expert validation assessment, with an average score of 91.6% in the very feasible category, the design expert validation obtained an average score of 88.3% in the very feasible category, and the limited test conducted on 6 second-grade students obtained results above 90% in the very feasible category. These results indicate that this media is feasible for implementation with second-grade elementary school students in the subject of length measurement.

In addition, the use of ethnomathematics and the SPADE model in learning helps students strengthen their understanding of standard and non-standard units through contextual activities using games based on local culture. This approach not only increases student engagement but also improves the overall effectiveness of learning. Thus, it can be concluded that ethnomathematics-based student worksheets with the SPADE learning model assisted by coconut shell stilts games not only provide an innovative approach to the learning process, but also facilitate effective and enjoyable learning, especially for second-grade elementary school students.

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