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Ethnomathematics Digital Student Worksheet Using the Problem Based Learning Model to Improve Creative Mathematical Thinking for Elementary School Students

Nur Atikasari[1*], Agus Efendi[2], Sri Yamtinah[3]

[1,2,3] Fakultas Keguruan dan Ilmu Pendidikan, Universitas Sebelas Maret, Surakarta, Indonesia
*Corresponding author: nuratikasari0@student.uns.ac.id

Abstrak

Kemampuan berpikir kreatif matematis yang rendah disebabkan oleh sulitnya pembelajaran matematika pada materi pembagian bilangan desimal. Oleh karena itu, penelitian ini bertujuan untuk mengembangkan LKS digital etnomatematika menggunakan model PBL untuk membangun kemampuan berpikir kreatif matematis siswa pada materi pembagian bilangan desimal di kelas V sekolah dasar. Jenis penelitian ini adalah penelitian pengembangan dengan model pengembangan ADDIE. Subjek penelitian ini yaitu 7 ahli materi dan 2 ahli media pmebelajaran. Subjek uji coba dalam penelitian dan pengembangan ini adalah 8 siswa. Teknik pengumpulan data menggunakan observasi, wawancara, dan kuesioner. Instrumen pengumpulan data berupa lembar kuesioner. Teknik yang digunakan menganalisis data yaitu analisis deskriptif kualitatif, dan kuantitatif. Hasil penelitian yaitu hasil penilaian yang diberikan oleh ahli materi pembelajaran yaitu 84,29% sehingga dinyatakan sangat baik. Hasil penilaian oleh ahli media pembelajaran terhadap yaitu 90,00% sehingga dinyatakan sangat baik. Hasil penilaian oleh siswa mendapatkan nilai rata-rata keseluruhan sebesar 81,52% sehingga sangat baik. Disimpulkan bahwa LKS digital etnomatematika menggunakan model PBL layak digunakan dalam pembelajaran. Implikasi penelitian ini yaitu penggunaan LKS digital etnomatematika menggunakan model model dapat meningkatkan berpikir kreatif pada siswa.

***Kata Kunci*:** *LKS Digital, Etnomatematika, PBL, Berpikir Kreatif*

Abstract

Low creative mathematical thinking ability is caused by the difficulty of learning mathematics on the division of decimal numbers. Therefore, this research aims to develop digital ethnomathematics worksheets using the PBL model to build students' creative mathematical thinking skills on division of decimal numbers in class V elementary school. This type of research is development research with the ADDIE development model. The subjects of this research were 7 material experts and 2 learning media experts. The test subjects in this research and development were 8 students. Data collection techniques include observation, interviews, and questionnaires. The data collection instrument is a questionnaire sheet. The techniques used to analyze the data are qualitative and quantitative descriptive analysis. The research results, namely the assessment results given by learning material experts, were 84.29% so they were declared very good. The assessment results by learning media experts were 90.00% so they were declared very good. The assessment results by students obtained an overall average score of 81.52%, so it was very good. It was concluded that digital ethnomathematics worksheets using the PBL model were suitable for learning. This research implies that using digital ethnomathematics worksheets using models can improve students' creative thinking.

Keywords: Digital Worksheets, Ethnomathematics, PBL, Creative Thinking

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1. INTRODUCTION

Mathematics is a field of science that plays a vital role in school and everyday life. Previous research shows that mathematics learning at school differs from everyday life, so it needs to be more contextual to students' lives (Alzaber et al., 2021; Gazali, 2016). Learning activities in 21st-century education also need to focus on skills that are relevant to the modern world, including the ability to think creatively and adaptively in the use of technology (Fatimah & Santiana, 2017; Hussin et al., 2019; Jufriadi et al., 2022). Creative thinking is the ability to produce ideas or solutions in the problem-solving process, which is characterized

by creating something new from ideas, descriptions, concepts, experiences, and knowledge that is useful and adaptive to the given task (Hadar & Tirosh, 2019; Perry & Karpova, 2017; Suherman & Vidákovich, 2022). Several indicators, such as fluency, flexibility, and originality, can measure creative thinking ability. Mathematics learning can shape students' creative thinking abilities (Aziz et al., 2016; Febrianingsih, 2022; Sulastri et al., 2015).

However, it cannot be denied that mathematics is considered one of the most challenging subjects for students (Amran et al., 2021; Hasiru et al., 2021). Previous research findings also reveal that many students still need help understanding mathematical concepts (Lestari & Putra, 2020; Mayudana, 2020; Nainggolan et al., 2021). Other research also states that it is difficult for students to understand learning material because the learning model or media used is inappropriate or inadequate (Setiawan, 2020; Suprianingsih & Wulandari, 2020). The interviews with teachers and students revealed that mathematics is a complex subject for most students, especially when dividing decimal numbers in the first semester. The learning media is in the form of teaching materials in the form of mathematics package books from one of the leading publishers in Indonesia. This book is contextual but far from students' lives, so the existing questions must be revised to encourage Higher-Order Thinking Skills (HOTS). Mathematics lessons are also considered monotonous because you have to memorize various formulas. During the learning process, students also experience boredom and boredom because learning is less attractive, so students' learning motivation decreases, which results in the learning process and results not running optimally.

Based on these problems, the solution that can be provided is to develop innovative learning media for mathematics learning. Teachers must be able to develop learning media that suit their needs to revive students' motivation to learn mathematics (Armin & Purwati, 2021; Hariati et al., 2020). Learning media are tools, means, intermediaries, and connectors for disseminating, carrying, or conveying messages and ideas so that they can stimulate students' thoughts, feelings, actions, and interests (Lestari et al., 2020; Mujahadah et al., 2021). One of the media that can be developed is Digital Ethnomathematics LKS using the Problem-Based Learning Model to improve students' creative thinking abilities. Mathematical creative thinking can be linked to a local culture, known as ethnomathematics (Manurung et al., 2020; Turmuzi et al., 2022). Ethnomathematics is a complex and dynamic representation that describes the influence of mathematical culture in its application (Dahlan & Permatasari, 2018; Hendriawan & Faridah, 2022). Through ethnomathematics, students can practice creative thinking skills. Ethnomathematics encourages students to think logically, analytically, systematically, critically, and creatively, which can be helpful in various aspects of life (Anam et al., 2019; Dahlan & Permatasari, 2018).

Teachers' application of ethnomathematics needs to be supported by a learning model based on student characteristics and existing resources. A learning model is a conceptual framework in the form of a systematic procedural pattern used to organize the learning process (Rahayu & Fahmi, 2018; Sudarmin et al., 2019). Ethnomathematics Digital Worksheets Using the Problem-Based Learning Model can help students learn. Learning models are essential for teachers in developing learning strategies and methods (Nurtanto et al., 2019; Praminingsih et al., 2023). Teachers are one of the factors that can determine the success of learning in the classroom because teachers deal directly with students (Istiandaru et al., 2015; Sutriyani & Widyatmoko, 2020). The required Mathematics learning model is contextual problem-based, relates to students' real world, is student-centered, and encourages increased student knowledge. One is the Problem-Based Learning (PBL) learning model (Hagi & Mawardi, 2021; Handayani & Koeswanti, 2021). PBL develops 21st-century skills such as flexible problem-solving, applying knowledge to real-world situations, and higher-order thinking skills such as critical and creative thinking (Lesi & Nuraeni, 2021; Surya, 2017).

Research conducted in recent years shows that students' creative mathematical thinking abilities can be built through the PBL learning model (Afsa et al., 2021; Handayani & Koeswanti, 2021; Kardoyo et al., 2020; Yunita et al., 2020). Other research also reveals that digital worksheets can help students learn wherever and whenever, making them efficient (Iskandar et al., 2020; Manalu et al., 2022; S. Rahayu et al., 2021). However, there has yet to be a study regarding Digital Ethnomathematics LKS using the Problem-Based Learning Model to improve elementary school students' creative mathematical thinking. The advantage of the Digital Ethnomathematics LKS using the Problem Learning Model that will be developed is that it is adapted to the characteristics of elementary school students and presents an attractive appearance, making it easier for students to learn. Based on this, this research aims to develop ethnomathematics worksheets using a problem-based learning model to improve students' mathematical creative thinking abilities in dividing decimal numbers in class V of elementary schools.

2. METHODS

This type of research is research and development (RnD), namely necessary research to find solutions to learning problems through certain products (Branch, 2009; Tegeh & Kirna, 2010). This research uses the ADDIE development model. The ADDIE development model uses five stages: analysis, design, development, implementation, and evaluation (Branch, 2009). At the analysis stage, an analysis of the problems that elementary school students often face when studying mathematics involves dividing decimal numbers. The design stage consists of determining the concept so that an initial overall design of the ethnomathematics worksheet can be developed digitally. The development stage involved developing ethnomathematics worksheets using a problem-based learning model. The evaluation stage is carried out in all stages of the ADDIE model.

The subjects of this research are material experts and learning media experts. The material validators were five elementary school mathematics teachers and two mathematics lecturers. Two media expert lecturers carried out the media validator. Students also provide validation by assessing the ethnomathematics worksheets they carry out. The test subjects in this research and development were eight class V students at SDIT Maarif NU Amirul Haq. The object of this research is an ethnomathematics worksheet using a problem-based learning model to improve students' mathematical creative thinking skills in dividing decimal numbers to determine test subjects using purposive sampling techniques. The data collection techniques used were observation, interviews, and questionnaires. Observations and interviews are used to collect data on problems in the field. Questionnaires are used to collect data in the form of expert assessments. The data collection instrument is a questionnaire sheet. The validity instrument in this research is a validation sheet, used to validate ethnomathematics worksheets filled in or assessed by the validator. The validation sheet contains statements using a Likert scale consisting of four alternative answers, namely 1, 2, 3, and 4. The questionnaire grid is presented in Table 1, and Table 2.

Table 1. Material Expert Validation Instrument Grid

No.	Aspect	Indicator	Questionnaire Items
1	Quality of Content/Material	Accuracy	1
		Balance	2
		Presentation of ideas	3
		Suitability	4
2	Learning Goals	Alignment with learning objectives	5, 6

No.	Aspect	Indicator	Questionnaire Items
		According to the characteristics of students	7, 8
3	Feedback and Adaptation	Learner feedback	9
4	Motivation	Ability to motivate	10

Table 2. Media Expert Validation Instrument Grid

No.	Aspect	Indicator	Questionnaire Items
1	Presentation Design	Visual design	1
		Processing	2
2	Interaction Usability	Convenience	3, 4, 5
3	Accessibility	Usage Design	6
4	Flexibility	Reuse	7
5	Standards Compliance	Compliance with Standards	8

The techniques used to analyze the data are qualitative and quantitative descriptive analysis. The results of the validator assessment analysis are obtained through a validation sheet, and the results are presented in table form containing the average score. Data collected from the average score is then converted using score conversion guidelines on a scale 5. Quantitative data is converted into qualitative data. Guidelines for converting quantitative data into qualitative data are presented in Table 3. After presenting the validation results, ethnomathematics worksheets using problem-based learning to improve students' mathematical creative thinking abilities are said to be valid if the scores obtained are in the valid or very valid category.

Table 3. Quantitative to Qualitative Data Guidelines

Percentage (%)	Predicate	Category
81 – 100	Very Good	Very valid, product not revised
61 – 80	Good	Valid, revised product
41 – 60	Enough	Enough, the product is revised
21 – 40	Not Good	Invalid, product revised
0 – 20	Very not Good	Very invalid, all products are revised

(Arikunto & Jabar., 2014)

3. RESULTS AND DISCUSSION

Result

This research aims to develop ethnomathematics worksheets using a problem-based learning model to improve creative mathematical thinking skills in fifth-grade elementary schools using the ADDIE model. First, analyze. The results of the analysis show that mathematics is a complex subject for most students, especially when dividing decimal numbers in the first semester. The learning media is in the form of teaching materials in the form of mathematics package books from one of the leading publishers in Indonesia. This book is contextual but far from students' lives, so the existing questions must be revised to encourage Higher-Order Thinking Skills (HOTS). Mathematics lessons are also considered monotonous because you have to memorize various formulas. During the learning process, students also experience boredom and boredom because learning is less attractive, so students' learning motivation decreases, which results in the learning process and results not running optimally.

Second is the design stage. At this stage, the concept is determined so that an initial overall design of the ethnomathematics worksheet can be developed in digital form as a link that can be accessed via the internet. Ethnomathematics worksheets are developed via the application https://app.wizer.me/. This ethnomathematics worksheet consists of ten questions covering four topics, including (1) counting (whole numbers): (decimal numbers); (2) calculating (decimal number): (decimal number); (3) division problems; and (4) type of calculation (making diagrams to help think). Third, development. At this stage, ethnomathematics worksheets are developed using a problem-based learning model. The results of product development are presented in Figure 1.

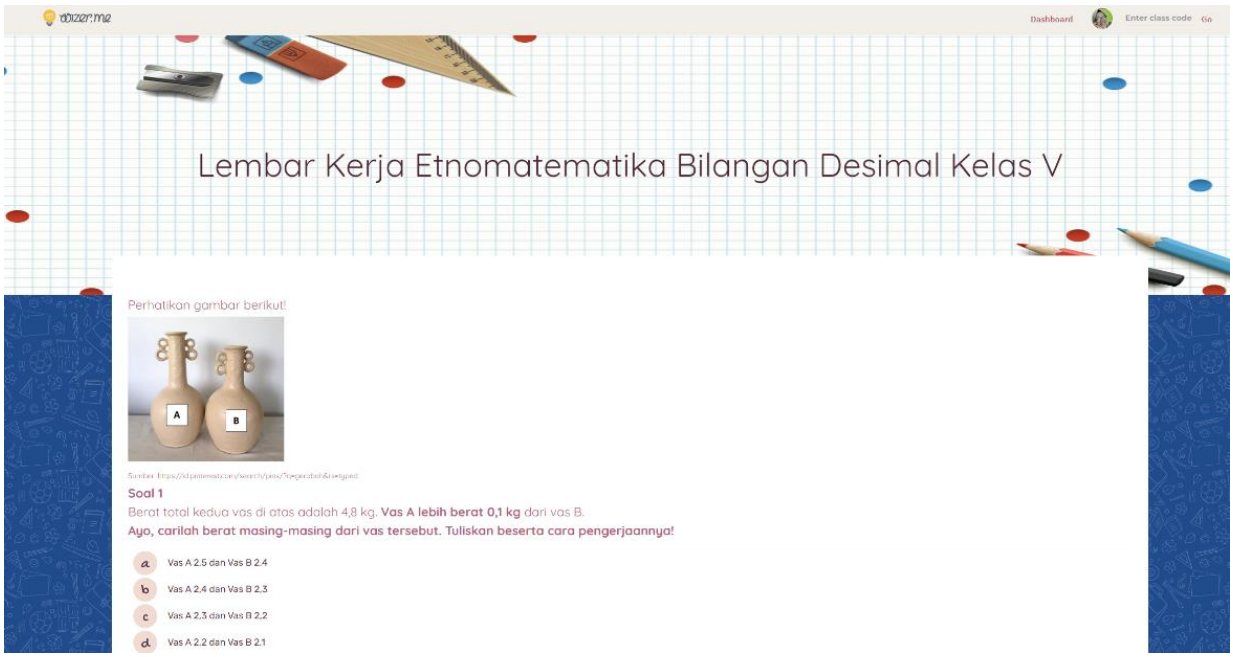

Figure 1. Results of Ethnomathematics Development Using the PBL Model

Ethnomathematics Using a Problem-Based Learning Model is then assessed by validators. Activities at the development stage are preparing ethnomathematics worksheets and evaluating them with mathematicians, mathematics teachers, students, and learning media experts through validation sheets. The purpose of validation is to obtain input, criticism, and suggestions for improvements to the perfection of the ethnomathematics worksheet being developed. The validation questionnaire was given to mathematics experts, namely two lecturers and five mathematics teachers. The results of LKS validation by material experts are presented in Table 4.

Table 4. Results of Ethnomathematics Worksheet Validation by Material Experts

Aspect	Average Score per Aspect	Category	Predicate
Content Quality	83.04%	Very good	Very valid
Learning Objectives	85.71%	Very good	Very valid
Input	85.71%	Very good	Very valid
Motivation	82.14%	Very good	Very valid
Average score	**84.29%**	**Very good**	**Very valid**

As for the results of the material validators, namely mathematics teachers and mathematics expert lecturers, as a whole, the average score was 84.29%. It can be concluded that according to the material validators, the ethnomathematics worksheets were declared "very good", and the material experts stated that the ethnomathematics worksheets were suitable for use. The validation of the ethnomathematics worksheet by media experts is presented in Table 5.

Table 5. Results of Ethnomathematics Worksheet Validation by Media Experts

Aspect	Average Score per Aspect	Category	Predicate
Presentation Design	87.50%	Very Good	Very Valid
User Interaction	95.83%	Very Good	Very Valid
Accessibility	91.67%	Very Good	Very Valid
Flexibility	87.50%	Very Good	Very Valid
Meet the Standards	87.50%	Very Good	Very Valid
Average Score	**90.00%**	**Very Good**	**Very Valid**

As a result of the media expert's assessment, the ethnomathematics LKS as a whole had an average score of 90.00%, so it was concluded that according to media experts, the ethnomathematics LKS was declared "very good". So it is suitable for use in learning. The results of the Ethnomathematics Worksheet Evaluation by Students are presented in Table 6.

Table 6. Evaluation Results of Student Ethnomathematics Worksheets

Aspect	Average Score per Aspect	Category	Predicate
Content Understanding	82.29%	Very good	Very valid
Language Presentation	77.08%	Good	Valid
Visual Appearance	82.10%	Very Good	Very Valid
Average Score	**81.52%**	**Very Good**	**Very Valid**

According to students, the ethnomathematics worksheet has an overall average score of 81.52%. These values were converted with the 5-scale conversion guidelines. From the average conversion results, it can be concluded that the ethnomathematics worksheets, according to students, are declared "very good." Apart from testing the validity of ethnomathematics worksheets, the validity of students' creative thinking instruments was also tested. The calculation of validity test results uses the Aiken Formula, with seven assessors from mathematics teachers and lecturers. So, Aiken's v-index is 0.76. After obtaining the estimated r-value, testing was conducted on the calculated value table to compare with Aiken's r-table. If the previous r value is greater than the Aiken table r value, then the items in the questionnaire are considered valid, and vice versa. If the r value is smaller than the Aiken table r value, then the items in the questionnaire are considered valid. Questionnaire items were declared invalid. The results of the validation calculations for student test instruments using the Aiken formula showed that all test items were declared valid by calculating r-value > Aiken's r-table (r-value > 0.76).

Reliability Test of Students' Creative Thinking Instruments. After the validity analysis, a reliability analysis was performed. The reliability test uses Cronbach's Alpha technique. The reliability test results above show that the reliability of the test instrument is 0.88 > 0.60. Thus, the test instrument is reliable. Test the Difficulty Level of Question Items. In the test instrument, it is also necessary to test the difficulty level of the questions. The results of the data analysis show that of the ten questions, four are in the medium category,

and six are in the easy category. Thus, the question item instrument is classified as a good question item worthy of testing. Apart from measuring the difficulty level of the questions, it is also necessary to test the level of distinguishing power of the questions. After calculating each question item using Microsoft Excel software, the results of the different power indexes of the question items must be interpreted.

Student tests are carried out after using the media. The validity and reliability results show that the instruments used to assess the quality of material and media are valid, so they can be used to measure the quality of media in learning. A value/score is obtained through the test results, which is used to measure media quality. The results of data analysis show that out of the total number of class V students of eight, it is known that five students have fulfilled the KKM and three students still need to fulfill the KKM, so a percentage of completion is 62.5% and 37.5% incomplete.

Discussions

The results of data analysis show that ethnomathematics worksheets using a problem-based learning model are valid and suitable for use in learning. Several factors cause this. First, ethnomathematics worksheets using a problem-based learning model are suitable because they make learning more accessible for students. The development of ethnomathematics worksheets was declared suitable for use in the learning process. This condition is also caused by the development process using an appropriate and systematic development model, thereby minimizing errors in the development process from the start (Duwi et al., 2021; Halija et al., 2021). The suitability of worksheets to student characteristics and learning materials will make it easier for students to learn (Anggraeni et al., 2021; Duwi et al., 2021; Ima et al., 2020). The ethnomathematics worksheet developed has a good category because the level of completeness is higher compared to students who still need to complete it. This means that students who have high mastery can be concluded to have high levels of creative mathematical thinking and vice versa (Dalilan & Sofyan, 2022; Khaerunnnisa & Pamungkas, 2019). High creative thinking scores indicate high mastery of the material and can be associated with better performance on tasks related to working memory and cognitive flexibility (Khaerunnisa & Pamungkas, 2018; Segundo-Marcos et al., 2024). This is because ethnomathematics worksheets were developed by correlating the learning material for dividing decimal numbers with students' lives or realities in the real world so that it can make it easier for students to understand the material better.

Second, ethnomathematics worksheets using a problem-based learning model are suitable because they stimulate students' creative abilities. Mathematical creative thinking ability is an individual's cognitive and metacognitive processes that produce innovative and adaptive ideas (Segundo-Marcos et al., 2024). Digital media such as ethnomathematics worksheets can be used as a space for students to develop their creative thinking. The digital environment is an optimal place for students' creative realization and provides opportunities to improve creative thinking skills by implementing learning practices using innovative tools and appropriate learning models (Fortinasari et al., 2022; Wang & Li, 2022). The LKS presents evaluation questions that aim to measure students' abilities after learning. The instrument questions are prepared using essay-type questions that require long answers or descriptions. This type of question was chosen to allow students to describe and write in detail the solutions they provide to solve problems. Referring to research, this type of essay question can be used by teachers to encourage students' creative thinking (McLure et al., 2024). Through essay questions, students can apply concepts in new contexts, explore different perspectives, and build scientific explanations for themselves (Widiana et al., 2023; Wilson et al., 2021).

Third, ethnomathematics worksheets using a problem-based learning model are suitable because they motivate students to learn. This ethnomathematics worksheet can create interaction between students and teachers. Digital-based learning media makes it easier for teachers because it can increase effectiveness and time efficiency, providing a concrete picture of mathematics material (Fitri et al., 2021; Khairunnisa & Ilmi, 2020). Research shows digital technology can improve conceptual understanding and develop intuitive abilities (Putrawangsa & Hasanah, 2018). His research also noted that the didactic function of digital technology in learning includes the following. First is technology's function as a support and alternative to learning media (Putrawangsa & Hasanah, 2018). Second is technology's function as a learning environment for honing skills (Fatimah & Santiana, 2017; Putrawangsa & Hasanah, 2018). Third, the function of digital technology as a medium for developing conceptual understanding. This means that to enter the era of the 21st century, there is a need to integrate digital technology into learning (Önür & Kozikoğlu, 2020; Putrawangsa & Hasanah, 2018). The use of ethnomathematics worksheets can encourage increased students' creative thinking abilities. Ethnomathematics presents a learning environment that allows the emergence of positive, enjoyable motivation so that mathematics is no longer considered a frightening specter. This certainly has an impact on increasing student learning motivation.

Previous research findings also reveal that technology-based media can make learning more accessible for students (Angriani et al., 2020; Darmayanti et al., 2022; Sabilla et al., 2020). Other research also explains that digital worksheets can make learning more accessible for students because they can be taken anywhere and are very practical (Pribadi et al., 2021; Suryawati et al., 2020). Ethnomathematics worksheets using a problem-based learning model make learning more accessible for students. The advantage of the developed ethnomathematics worksheet is that it can increase students' understanding of the material while teaching the cultures around students so that a cultured character can be formed. The limitation of this research is that the ethnomathematics worksheets using the problem-based learning model that was developed were limited to validity testing from experts and students, and product effectiveness tests had yet to be carried out. However, ethnomathematics worksheets using the problem-based learning model developed can be used in mathematics learning because they have very good validity from experts and students. This research implies that ethnomathematics worksheets using a problem-based learning model can help students learn mathematics.

4. CONCLUSION

The ethnomathematics worksheets developed based on the ADDIE development model received valid qualifications from experts and students. Ethnomathematics worksheets using a problem-based learning model are suitable for mathematics learning. The developed ethnomathematics worksheet can be used as an alternative interactive learning media in mathematics learning, specifically for fifth-grade elementary school students. The results of the tests concluded that this ethnomathematics worksheet could improve students' mathematical creative thinking abilities.

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