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Development of an ethnomathematics-based digital flipbook module for least common multiple and greatest common divisor in the fourth grade of elementary school

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Abstract

Indonesian school-age children generally have lower mathematics competence compared to those of other countries. One of the ways to solve this problem is through the introduction of the ethnomathematics approach associated with everyday life and culture. This study aims to develop and determine the quality and feasibility of the digital flipbook module with an ethnomathematics approach for the greatest common divisor and least common multiple materials for the fourth grade of elementary school. The data were collected through a questionnaire with quantitative and qualitative analysis. This study indicates that the current research and development has achieved the expected quality of the digital flipbook module, which has been validated by media, language, material, and learning experts. The score resulting from media validation was 84.4, the material expert was 84, linguists was 76, and learning expert was 88, and thus the average assessment of this module was 83.2, which is classified as a very good category. In terms of priorities, with limited trials, the assessment score of the teacher's response was in the good category with 92, and the average score of student assessment was 94 or in a good category. The average assessment from expert validators, teachers, and students was 86.46, which was classified in a very good category. Thus, the digital flipbook module with an ethnomathematics approach for least common multiple (KPK) and greatest common divisor (FPB) materials developed by researchers is suitable for use in learning.

Keywords: *Ethnomathematics, elementary school teacher education students, learning implementation plan, Yogyakarta Palace*

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INTRODUCTION

Elementary school education has a great influence in providing reinforcement for students by way of building cognitive, affective, and psychomotor constructions (Atikah et al., 2020). Learning activities at the elementary school level should be carried out properly with an appropriate and careful guidance. It is suggested to use an approach adapted to students' psychological development at school, which particularly requires attention and broad insight, one of which is in terms of mathematics learning (Ghasya et al., 2021). Lugonzo (2020) articulated that math and scientific skills serve as a driving force for economic and technological development in the society. Reinforcement is provided to students through the introduction of mathematical concepts in order to improve students' understanding in solving mathematical problems. All worldwide countries are seeking to enhance their knowledge especially in the fields of mathematics and science. Mathematics learning encompasses abstract concepts and tiered principles which often leads to

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learning problems, and many students consider this subject as difficult (Rismawati & Khairiati, 2020).

Overall, Indonesian students score low in their mathematical ability as revealed by the average score of Indonesians in the National Assessment Program (NAP). Masykur (in Rohmah, 2020) argued that many students deemed mathematics as difficult, confusing, and thus this subject is feared by most students. This happens because mathematical concepts are difficult to understand, due to the extensive number of formulas and calculations to solve complex problems that lead to students' boredom and fear of mathematics.

On this basis, in the process of understanding mathematical concepts, participants play a very important position in supporting the teaching and learning process. One of the success factors in the learning process to help students acquire profound mathematic skills is the teacher's ability. Anwar (in Wiryanto, 2020) delineated that teachers play an essential role in mastering and developing an appropriate methods for the learning process by way of adjusting the materials to the students' characteristics to achieve the learning objectives.

Learning media serves as a tool for teachers in communicating learning materials to students. Learning media that is in line with the learning materials will generate effective learning process, especially when the learning media are made according to the interests and preferences of the students. This way, students can easily understand the provided materials.

The global outbreak of Covid-19 has recently altered the regular direct face-to-face learning (offline learning) between teachers and students in Indonesia, since the announcement of the first Covid-19 patient on the 2nd March 2020 (Sukur et al., 2020). Such never-before-seen incident has dramatically disturbed various sectors, both the economy and the education sector. Covid-19 has had a massive adverse impact on all educational institutions around the world. The total closure of all educational institutions globally is aimed to curb the rapid transmission of Covid 19. UNESCO (in Putria et al., 2020) stated that Covid-19 had a considerable impact on more than 1.5 billion students worldwide from 188 countries, and 60 million of whom are Indonesian students.

To alleviate the considerable disruptions attributed to Covid-19, at the global level, various countries are taking action by transitioning to online learning programs, such as through distance learning, and introduction of social sites, and digital applications to allow interaction between teachers and students to achieve the desired learning goals. The use of technology serves as a reference for teachers to help them present a learning process that allows room for student's movement to facilitate interaction and collaboration between students and students and teachers and students primarily in elementary school mathematics learning.

It is pivotal to adjust the use of learning media in the online learning process to the level of students' development (Ghasya et al., 2021). Based on the level of students' development, according to Piaget, ages 6-11 years are in the concrete operational stage (Kelanang & Zakaria, 2012; Wiryanto, 2020). Therefore, to instill the basic concepts of mathematics, teachers must primarily begin by presenting concrete material before abstract materials, so as to ease students' comprehension. To achieve the desired online learning process, teachers need information technology and teaching aids or media that meet the required use of internet to support the learning implementation.

The use of internet as a medium for online learning has a good impact on the achievement of learning goals (Tabor & Minch, 2013). However, not all regions in Indonesia are provided with good internet network. Numerous areas are having difficult to access the internet network, and thus deterring the achievement of learning objectives. The use of digital-based learning modules that can be downloaded freely via the internet is beneficial for students (Williamson et al., 2020). Sousa (in Roemintoyo & Budiarto, 2021) held that digital learning refers to a particular media content in the form of text or images widely made available on the internet for learning module with the aim of increasing teaching effectiveness.

In this study, learning module is defined as a collection of materials designed for students' independent learning during a particular learning process. Students can use the module independently to help understand the provided learning materials, since instructions are clearly written for independent learning (Fahmi et al., 2019). Therefore, the module can be used without the direct presence of a teacher, which is appropriate for use during pandemic situations as a way to achieve the best learning outcomes. This study aims to develop a digital module using Kvisoft Flipbook

Maker, which converts documents in PDF into digital publications to be displayed in various ways, including in video, audio, and images covered in a digital module. Prasetyono (in Roemintoyo & Budiarto, 2021) argued that the use of flipbook-based digital books can improve students' logic and skills, especially in mathematics thinking skills.

Mathematics learning in SD (elementary school) MA covers Least Common Multiple and Greatest Common Divisor materials. However, many students are finding it difficult to solve the type of narrative questions, particularly whether they have to use the formula of Least Common Multiple and Greatest Common Divisor. In addition to observing SD MA, the researcher also encountered a problem when teaching in an educational institution, where the fifth grade of elementary school were still confused by the concepts of Least Common Multiple and Greatest Common Divisor. Least Common Multiple and Greatest Common Divisor is one of the abstract mathematical concepts in elementary schools. Thus far, many teachers only rely on the explanation and formula from books in explaining the material for Least Common Multiple and Greatest Common Divisor.

As it is known, after learning mathematics, students are required to develop critical thinking skill (Imswatama & Lukman, 2018). Critical thinking requires students to solve mathematical problems with everyday life, life values, and culture in their surroundings, so that mathematics learning not only contains mathematical concepts, but also about the pervasive cultural values the society. Ethnomathematics is an appropriate approach to develop this need.

Ethnomathematics is derived from two words, "ethno" and "mathematics". Ethno refers to a cultural group, and mathematics is an activity in the form of measuring, clarifying, sorting, summing, and modeling (Septianawati et al., 2017). Some human activities require the application of mathematical ideas, since human daily activities constitute counting, discovering, measuring, playing games, designing, and explaining. These activities are concrete activities in everyday life. Ethnomathematics approach links cultural values in the community with mathematical concept, and thus this approach it is very suitable to develop this approach in Indonesia, which consists of diverse cultures spreading throughout the country.

To apply the concept of Least Common Multiple and Greatest Common Divisor by incorporating ethnomathematical elements, teachers can use traditional games typical of certain regions by relating it to the concept of Least Common Multiple and Greatest Common Divisor as a way to ease students' understanding. Ethnomathematics approach is used to understand how mathematics is adapted from a culture and serves to express the relationship between culture and mathematics (Rubio, 2016). In other words, ethnomathematics concerns with the study of culture of the community, historical heritage related to mathematics, and mathematics learning.

In the 2013 curriculum syllabus, the Least Common Multiple and Greatest Common Divisor concepts are provided since the fourth grade of elementary school. On this basis, researchers need to adjust the material to the development of the fourth grade of elementary school students. In principle, elementary school students are fond of pictorial and attention-grabbing objects, which raise students' curiosity. Hence, developing a flipbook learning media will enhance students' learning interest. Flipbook is a learning module that is packed in animated and colorful form, making it suitable for use by elementary school students. The learning module of a flipbook is one of the media that teachers can use in communicating and delivering material to students.

Thus far, there has been no research to explore ethnomathematics values associated with the Least Common Multiple and Greatest Common Divisor concept, especially in children's traditional games. Moreover, based on the observations made in SD MA, and private educational institutions, researchers identified ethnomathematics values in children's traditional games that can be linked into ethnomathematics. This attracts the researchers' interest to develop a digital flipbook module as ethnomathematics-based learning media for Least Common Multiple and Greatest Common Divisor concept. This learning module can be used by teachers to help students understand the learning materials. This module consists of various components, including learning materials, questions, answers, and traditional games in accordance with the Least Common Multiple and Greatest Common Divisor material. The development of this learning media is expected to sharpen students' critical thinking skills by analyzing, evaluating, and applying mathematical theory to everyday life, and solving problems related to ethnomathematics.

This research is formulated based on the following research problems: 1.) What are the steps for developing a digital flipbook module with an ethnomathematics approach for Least Common Multiple and Greatest Common Divisor concept?; 2.) How is the quality of the digital flipbook module with an ethnomathematics approach for the Least Common Multiple and Greatest Common Divisor concept in the fourth grade of elementary school?; and 3.) What is the feasibility of the digital flipbook module with an ethnomathematics approach for the Least Common Multiple and Greatest Common Divisor concept in the fourth grade of elementary school? The benefit of this research lies in the possibility to help the learning process and to achieve learning objectives, especially during the implementation of online learning.

METHOD

This is the Research and Development (R&D) model of research to develop a digital flipbook module with an ethnomathematics approach for Least Common Multiple and Greatest Common Divisor concept for the fourth grade of elementary schools based on the Sugiyono development model. This model consists of 10 research stages, but researchers only developed it into 7 stages, namely: potential and problems, data collection, product design, design validation, design revision, product manufacture, and product revision (Sugiyono, 2013). The research and development steps was done according to Sugiyono (2013).

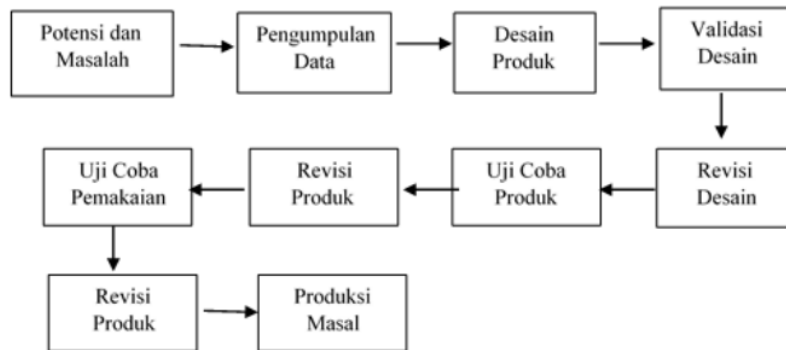


Figure 1. Steps to Use Research and Development (R&D) Methods (Sugiyono, 2013)

Data were collected through interviews, observations, and questionnaires based on the assessment of expert (media expert, material expert, linguists, and learning expert). Data were analyzed using qualitative and quantitative technique. Qualitative data analysis was used to improve the digital flipbook module with an ethnomathematics approach through suggestions, comments, and input from expert. The quantitative data obtained from the research questionnaire on the digital flipbook module with an ethnomathematics approach was validated by expert.

The assessment of the questionnaire in the observation sheet from the expert was conducted using a Likert scale. The scoring category based on the Likert scale in this study is presented in Table 1.

Table 1. Likert Scale Scoring Category

No.	Score	Description
1.	5	Strongly Agree
2.	4	Agree
3.	3	Neutral
4.	2	Disagree
5.	1	Strongly Disagree

Source: (Sugiyono, 2016)

The score generated from the expert assessment was calculated using certain formula (Sugiyono, 2016). The average score of the overall assessment was converted into the assessment criteria (Arikunto, 2010). Conversion of the overall score from the assessment was done according to Arikunto (2010), as presented in Table 1. A conversion table with a Likert scale was used to determine whether the flipbook digital module with an ethnomathematics approach is very suitable for helping the learning process. The ethnomathematics-based flipbook digital module is said to be very feasible and can be used in the learning process if the minimum category is "Good" and has a percentage score of more than or equal to 61.

RESULTS AND DISCUSSION

The development of flipbook digital module media with an ethnomathematics approach was carried out in research development stages by Sugiyono (2013), which were limited to the following seventh stage: 1.) Potential and problems; 2.) Data collection; 3.) Product design; 4.) Design validation; 5) Design revision; 6) Product manufacture; and 7) Product revision.

Potential and Problems

This research was conducted based on the potential and problems obtained by the researcher during the observation. The problem arose because an unwanted process occurred. Before the Covid-19 pandemic, researchers found some learning problems in SD MA and KC tutoring institutions, since students found it difficult to understand mathematical concept of Least Common Multiple and Greatest Common Divisor. Students found it hard whether to use Least Common Multiple or Greatest Common Divisor theory to solve a narrative question. To overcome this problem, students may need an ethnomathematics-based digital flipbook module to ease them in understanding the concept of Least Common Multiple and Greatest Common Divisor.

Data Collection

The results of interviews with teachers and students help researchers in developing a learning module. Observations were made to find out problems in the learning process of Least Common Multiple and Greatest Common Divisor concept. Data were collected to find out problems in the learning process of Least Common Multiple and Greatest Common Divisor concept and to find reference in developing media to facilitate students in reading skills and attract students' attention.

Product Design

At the initial stage of product design, the researchers needed to do the followings to design the product: 1.) Determining the design or image on the cover, content, and back cover of the digital flipbook module; 2) After creating the cover, the researchers were required to determine the learning material content adjusted to the Core Competencies and Basic Competencies, as well as the developed indicators; 3.) Determining the types of traditional games to be linked to the Least Common Multiple and Greatest Common Divisor materials; 4.) Designing pictures and videos of the contents of the digital flipbook module with an ethnomathematics approach; 5.) Writing work instructions in the digital flipbook module; and 6.) Making evaluative questions and exercise in each material. Examples of screenshots of the front and back covers of the developed digital flipbook module can be seen in Figure 2 and Figure 3.

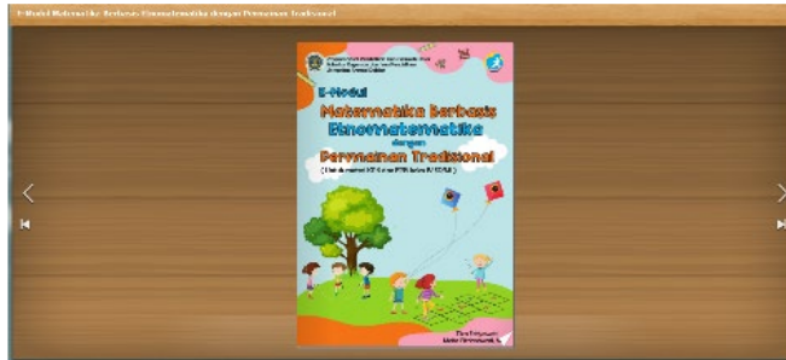


Figure 2. Screenshot of the Front Cover of the Flipbook Digital Module



Figure 3. Screenshot of Flipbook Digital Module Back Cover

Design Validation

Before validation by the four expert, namely media expert, material expert, linguists, and learning expert, the first step was instrument validation. The instrument validation was carried out by an expert in the field of mathematics and was approved on May 10, 2021. The instrument validation was carried out to test the feasibility of the assessment instrument for media expert, material expert, linguists, and learning expert. After the instrument was declared feasible, the next stage was to validate the ethnomathematics-based flipbook digital module by media expert, particularly in the electronics field, material expert from ethnomathematics expert, linguists, and lecturers of elementary education as learning expert.

Data from Media Expert Validation Testing

The media validation testing of the ethnomathematics-based flipbook digital module was carried out by media expert in the electronics field. The testing by media expert was carried out once on June 2, 2021. The validation testing based on the media expert generated a score of 106 or an average score of 84.8 and was classified as “Very Good” category. In addition to testing the module, the expert also provided some suggestions and input to improve the flipbook digital module and to adjust it for learning use.

Data from Material Expert Validation Testing

The material validation testing of the ethnomathematics-based digital flipbook module was carried out by a lecturer as well as an expert in the field of ethnomathematics. The validation testing on the learning materials presented on the digital flipbook module was carried out on May 19, 2021. The validation testing generated a total score of 63, and a score of 84, which was classified as "Very Good". The expert suggested that all questions in the flipbook must be based on ethnomathematics approach.

Data from Linguistic Expert Validation Testing

The language validation testing on the ethnomathematics-based flipbook digital module was carried out by a linguist who was also a lecturer in Elementary School Teacher Education (PGSD). The validation testing on the language aspect of the flipbook digital module was carried out on May 24, 2021. The testing obtained the score of 38 and an overall score of 76, which was classified into "Good" category. The linguist suggested correcting some punctuation and writing of foreign words and regions in italics.

Data from Learning Validation Testing

The learning validation testing by learning expert on the ethnomathematics-based flipbook digital module was carried out by Elementary School Teacher Education (PGSD) lecturer as the learning expert. The validation testing on the learning aspects of the flipbook digital module was carried out on May 25, 2021. The testing generated the total score of 44 and overall score of 88, which was classified as "Very Good" category. The expert suggested that the lesson plan should put more emphasis on students' active participation rather than teachers.

Design Revision

At this stage, revisions were made after the products created by researchers were validated by expert and received some input regarding the shortcomings of the developed flipbook digital module design. After having the validation testing, the researchers made some improvements to minimize the shortcomings and optimize the strength of flipbook digital module for optimal use in accordance with input from expert.

Product Trial

After revising the product design, a limited product trial was carried out on the flipbook digital module by taking a sample of sixth grade elementary school teachers in areas with multitude of cultural access and are located on the outskirts of Yogyakarta. Product trials were carried out by involving 10 higher graders with diverse abilities. The assessment by the teacher was carried out on June 17, 2021. The teacher's assessment on the developed digital flipbook module obtained a score of 46 and an overall score of 92, which was classified as the "Very Good" category. Student assessment of the digital flipbook module was held on June 18, 2021 in Yogyakarta. In total, these 10 students scored the flipbook with 94, which was included in the "Very Good" category.

Product Revision

The product revision stage aims to correct the deficiencies in the digital flipbook module which was developed based on input, suggestions, and the results of limited trials carried out on research subjects, namely teachers and students. The product was revised based on suggestions from teachers and students as way to create a high-quality and feasible digital flipbook module for use.

Integrating the concept of ethnomathematics into mathematics learning is carried out as an effort to develop students' character and introduce them to the local cultural values in their surroundings, especially through traditional games commonly played by the fourth graders of elementary school. This is in line with opinion D'Ambrosio (2006), who articulated that ethnomathematics is very close to the real context existing in society. In addition, ethnomathematics is a method used by a group of people in their daily activities by combining between mathematical

concepts, such as a house architecture, which is composed of various forms of three-dimensional figures to the concept of arithmetics in traditional children’s games.

Elementary school children aged 7-11 years, generally, have acquired a concrete operational level of understanding. This is in accordance with the opinion of Piaget and Inhelder (2010) that children of this age will understand a concept by displaying real objects or giving parables with all regular daily activities. Furthermore, Herawaty et al. (2019) held that mathematics is one of the subjects that have abstract concepts. Thus, teachers are expected to explain mathematical concepts to students, especially those in the age range of 7-11 years old, by giving examples and by relating the mathematical concepts to real-life objects or daily activities carried out by students.

In accordance with the problems experienced by researchers, most students found it difficult to distinguish whether to use the concept of Least Common Multiple or Greatest Common Divisor to solve narrative mathematical problems. Given the Covid-19 pandemic, the researchers decided to make electronic-based learning media that can be easily accessed by students whenever and wherever they will use it (Akrim, 2018). The results of the development of a digital flipbook module with an ethnomathematics approach, especially for Least Common Multiple and Greatest Common Divisor materials, were introduced to students in the fourth grade of elementary school. On this basis, researchers developed media for the fourth grade of elementary school, because providing students with the basic understanding of the material will make it easier for students to remember the concept.

The Least Common Multiple and Greatest Common Divisor concept was provided for the fourth grade of elementary school from the basics. The e-module will introduce multiples and factors, prime numbers and prime factorization, least common multiple, and Greatest Common Divisor to students. To explain multiples, the researcher related this mathematical concept with the score calculation of traditional *benthik* game. The implementation of the material for multiples on the developed digital flipbook is presented in Figure 4. For the Factor material, the researcher related the concept to the traditional game of *nekeran* or marble game. The implementation of Factor material on digital flipbook media underdeveloped is illustrated in Figure 5. Students can get to know the way to play *benthik* by watching the provided videos. The researchers also related this game with the concepts of multiples and factors in the video.

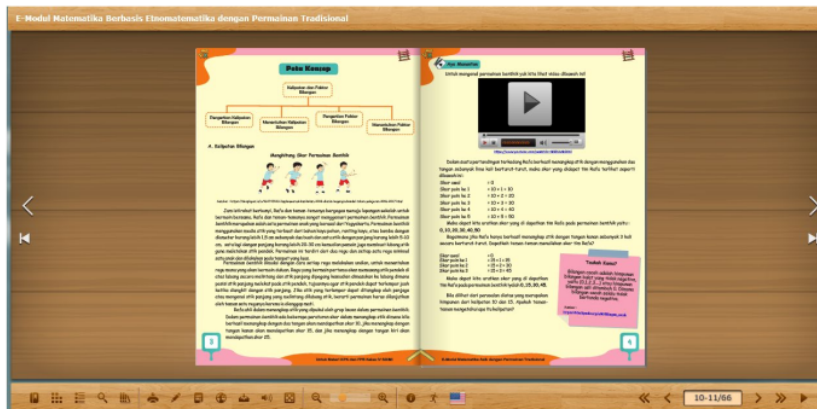


Figure 4. Ethnomathematics Concepts in Multiples

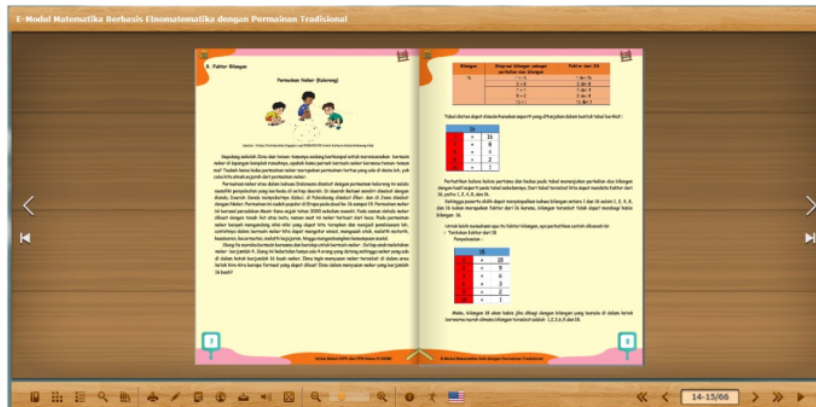


Figure 5. Ethnomathematics Concepts in Factors

Having understood the concept of multiples and factors, students can understand the concepts of prime number and prime factorization. To explain the concept of prime number, the researcher related it with the *engklek* game, which can introduce the concept of prime numbers and prime factorization through the *gunungan* pattern in the *engklek* game. The concept of ethnomathematics in prime numbers and prime factorization in the *engklek* game incorporated in the developed digital flipbook module is presented in Figure 6. To explain the concept of prime numbers and prime factorization, the researcher also inserted a video on how to play *engklek* to introduce students to practice it. The researcher also provided an additional note “Did you know” to enrich students’ knowledge. An example of this additional information through “Did You Know” is provided in Figure 7.

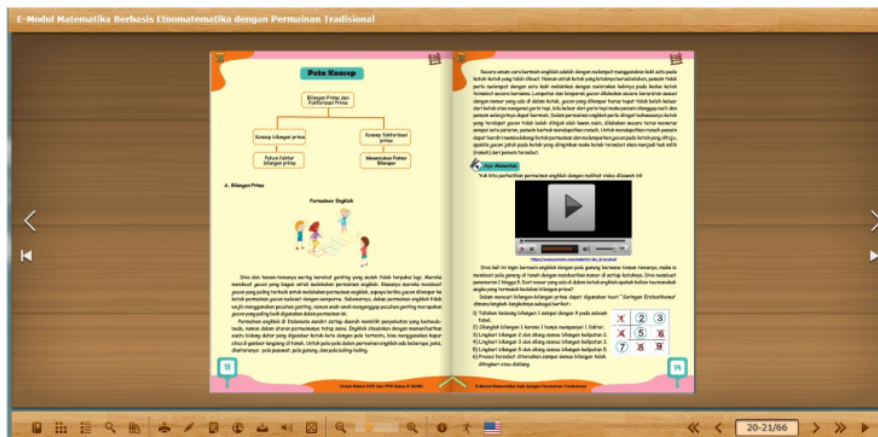


Figure 6. Ethnomathematics Concept on the Concept of Prime Numbers and Prime Factorization in the *Engklek* Game

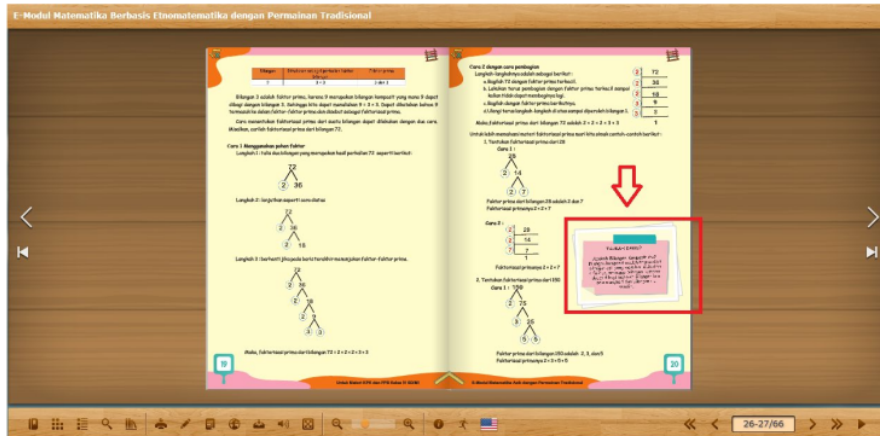


Figure 7. “Did You Know” Notes

After explaining the basic concepts, the next material in this e-module relates ethnomathematics concepts to the Least Common Multiple and Greatest Common Divisor materials. The Least Common Multiple material in the created digital flipbook module explains the concept of the *long bumbung* game. In the *long bumbung* game, a story is narrated with a time difference problem to turn on the *long bumbung* in two teams. A problem narrated through the *long bumbung* game is expected to help students understand and learn the concept of Common Multiple before understanding the concept of the Least Common Multiple. The implementation of the concept of Common Multiple in *long bumbung* game on the developed digital flipbook module can be seen in Figure 8.

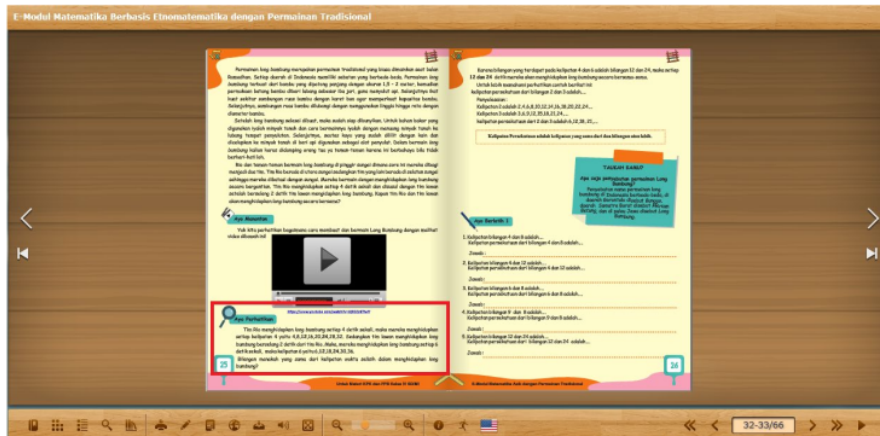


Figure 8. The Concept of Common Multiples in The *Long Bumbung* Game

The Greatest Common Divisor concept is introduced in the e-module by relating it with *Lompat Tali* (Jumping Rope) traditional games. The material is presented in a problem in dividing the remaining rubber bands from the process of making a jump rope. The researcher explained the concept of dividing the rubber bands evenly through a learning video. This is done in order to ease students’ understanding. The implementation of the concept of dividing rubber bands on the material to find Common Factors is illustrated in Figure 9.

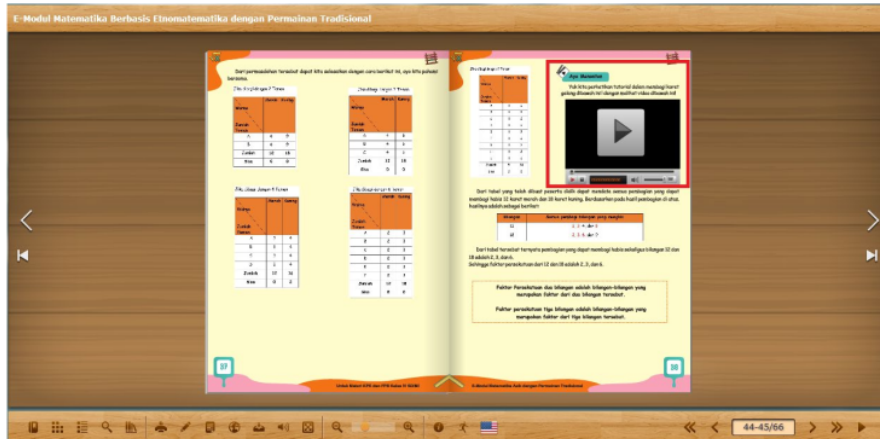


Figure 9. The Concept of Dividing Rubber Bands on the Material of Finding Common Factors

In addition to linking ethnomathematics concepts in Least Common Multiple and Greatest Common Divisor materials, this e-module contains evaluation questions based on Higher Order Thinking Skills (HOTS) with an ethnomathematics approach by providing problems related to children's traditional games. An example of the implementation of evaluation questions in the developed e-module is portrayed in Figure 10.

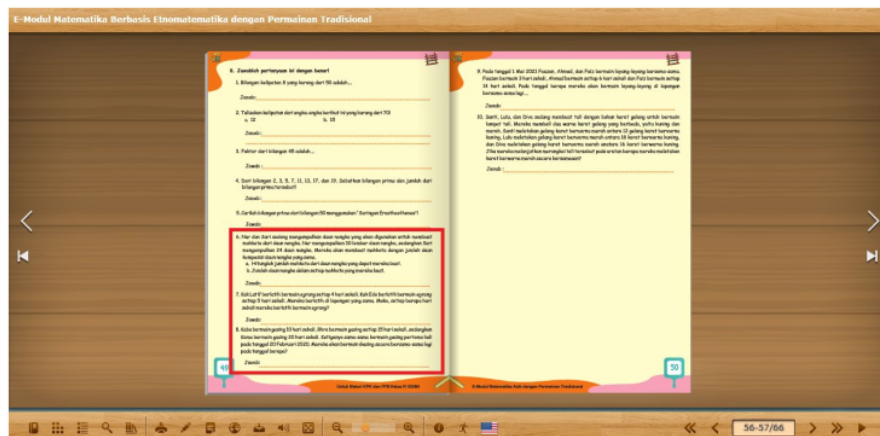


Figure 10. Evaluation Questions with an Ethnomathematics Approach in Traditional Games

CONCLUSION

Based on the development of the ethnomathematics-based digital flipbook module for the Least Common Multiple and Greatest Common Divisor material for the fourth grade of elementary schools, the following conclusions are drawn: 1.) Media development refers to the Borg and Gall model assessment procedure, which has been simplified by Sugiyono with the following steps: potential and problems, data collection, product design, design validation, design revision, product testing, and product revision; 2.) The quality of the digital flipbook module which has been validated by media expert, materials expert, linguists, and learning expert has an average score of 83.2 and is

1 in the very good category; and 3.) The feasibility of the digital flipbook module is seen from the teacher's response to the product trial which scored 92, which was in very good criteria and limited product trials by students getting an average score of 94 with very good criteria. The average score of the validator's assessment of media expert, material expert, linguists, learning expert, teacher assessments, and students, was 86.46 with very good criteria. Hence, the currently developed digital flipbook module adapted to the Least Common Multiple and Greatest Common Divisor material with ethnomathematics approach for the fourth grade of elementary school is feasible for use.

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