



## Dakon Koper Media of the Least Common Multiple and Greatest Common Divisor Materials for the Elementary School Students

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**Abstract:** The Program for International Student Assessment (PISA) in 2018 showed that elementary school students' math, literacy, and science skills were poor. These problems occurred due to a lack of understanding and memorization of multiplication. They are considered difficult for students to calculate the results of the least common multiple and greatest common divisor. Thus, the development of learning media in mathematics are needed. The developed media was Dakon Koper. The purpose of this study was to develop Dakon Koper media in thematic learning. This research was a development research by implementing the ADDIE model which consisted of analysis, design, development, implementation, and evaluation. The subjects of this study were the fourth-grade elementary school students. The developed media's feasibility had been determined through a validation questionnaire filled by media, material, and learning experts. Student response questionnaires were used to record students' interest in learning. The expert validation results stated that Dakon Koper was very suitable to be used as a learning medium. The students' questionnaire responses revealed that Dakon Koper was very interesting and useful to support students' learning. Suggestions for the sustainability of this research are product dissemination for learning media in elementary schools.

## INTRODUCTION

The results of the 2018 PISA data analysis showed a score decrease compared to the previous year. The reading, mathematics, and science scores were 371, 379, 396 (Nugrahanto & Zuchdi, 2019). Mathematic learning is considered difficult and tedious by the student in elementary school (Ekowati & Suwandayani, 2020; Godino et al., 2011; Hartshorn & Boren, 1990; Johnstone, 1991; Schmidt, 2004). This assumption creates a further problem in learning mathematics. When learning mathematics, students often turn their

attention to other things, such as talking with friends or playing. This attitude causes students not to focus on and hard to understand the learning material. It will impact the difficulty of understanding mathematics material properly and correctly (Siregar, 2017).

The results of preliminary observations in Indonesia on the least common multiple and most significant common divisor materials in the fourth-grade indicated that students experienced misconceptions (Fauziah, 2011; Godino et al., 2011). Even though the materials are relatively simple, they use simple or less

complicated formulas and explicit theories (Plass & Kaplan, 2016). The least common multiple and greatest common divisor questions can be solved using factor trees, data sets, and tables (Ambrose, 2004). However, students could not determine which results belonged to the least common multiple or greatest common divisor if they were asked to simultaneously search the results. Amir (2014) argues that the problems are caused by students' low learning outcomes in the least common multiple and greatest common divisor materials. Based on the results of the PIRLS data, the mathematics sector in Indonesia is poor. This obstacle in learning mathematics cannot be underestimated (Kartika, 2018; Rosita, 2014) because mathematics is a very crucial subject (Mirati, 2015). Mathematics subject has an important role in developing students' mathematical abilities in general (Burais et al., 2016; Herman, 2007; Siagian, 2016).

The first common obstacle was that students were often confused in determining the least common multiple and greatest common divisor. Based on Indonesia's previous research, the teacher always reminded and wrote special notes on the board about the differences between the least common multiple and greatest common divisor. The preliminary study results showed that students often ignored the notes, which caused errors in determining the materials. This habit affected their exam results. The second obstacle was that five to thirteen students had difficulty determining the factorization and multiplication of a number because they could not memorize the multiplication formula. In the end, the students made mistakes in determining the least common multiple and greatest common divisor of a certain number. Understanding mathematics can be done in everyday life (Sutisna et al., 2016). There are components of mathematics learning that should be embedded in

everyday life, among others: (1) essential concept planning, namely new concepts where students have never learned; (2) concept understanding, which is a part of continuous learning for students to understand concepts better, and (3) coaching skills, that is a mathematical concept that can be applied skillfully.

The needs analysis indicated that it is necessary to develop instructional media for the least common multiple and greatest common divisor. Learning media is very influential (Harahap & Siregar, 2018; Putra et al., 2014; Sugianto et al., 2017). They believe that learning objectives can be achieved by determining and using learning media in learning activities.

Media consist of various kinds (Gusmida & Islami, 2017; Plass & Kaplan, 2016). Several learning media can be used by teachers (Harahap & Siregar, 2018), for example, photos, charts, graphics, and posters that are classified as visual media. Graphic media has the same meaning as two-dimensional media, which contains length and width. The next classification is three-dimensional media in models, such as concrete models, cross-sectional models, stacking models, mock-ups, and many others. Furthermore, slide, film, and OHP are included in projection media. The last classification is the environmental media. Among the various types of media, Dakon Koper is included in the three-dimensional media. Dakon Koper is shaped like a traditional Dakon, which has several circular containers. The dakon is placed in a suitcase container. The researchers chose Dakon because it is often used in learning addition, subtraction, multiplication, and division. The least common multiple and greatest common divisor materials contain multiplication and division operations. Using dakon, students can understand the mathematical operation easier (Ekowati & Suwandayani, 2020; Khairiyah, 2019). Students have already played dakon and

have no difficulty operating it since they were already familiar with its rules. The Dakon is placed in a suitcase to make it easier to carry. When using Dakon that requires a circle of more than 30, they must carry two large Dakon (Ekowati & Suwandayani, 2020; Fauziah, 2011). Therefore, a suitcase is used and is called Dakon Koper, which functions to facilitate students in calculating the results of the least common multiple and greatest common divisor questions wherever they are. Dakon can be placed in a suitcase to make it easy to carry. Often when using dakon that requires more than 30 circles, the teacher has to carry two large dakon boards, which might be troublesome (Godino et al., 2011; Gusmida & Islami, 2017). Therefore, a suitcase concept is introduced and called Dakon Koper that functions to facilitate students in calculating the least common multiple and greatest common divisor questions.

Based on the description, the purpose of this research was to implement the process of developing Dakon Koper media on the least common multiple and greatest common divisor material. This development research is essential because it will allow more comfortable understanding and engagement for students in learning activities. Besides, the material can be understood easily because students experience concrete examples of theoretical use in practice. In learning activities, media can foster students' motivation so they do not feel bored quickly. Dakon Koper media can make students more active in participating

directly in the learning activities as well as fostering a spirit of cooperation between students in group learning activities. The benefits of the media are in line with the opinions expressed by (Harahap & Siregar, 2018; Plass & Kaplan, 2016; Sugianto et al., 2017). The function of learning media is 1) as a means of conveying clear information, 2) fostering students' attention and motivation, 3) not constrained by limited space, time, and senses. The second benefit of developing Dakon Koper media for teachers is to assist the classroom's teaching and learning process. The media can also provide innovations to develop mathematics learning media for fourth-grade elementary school students. The third benefit is for researchers to develop useful learning media in the learning process using creative and innovative skills.

## METHOD

This research implemented the Research and Development method using the ADDIE development model. The model consists of 5 stages: Analyze, Design, Develop, Implement, and Evaluate. According to Creswell (2014) and Hartshorn & Boren (1990), the ADDIE model consists of five stages that are easily understood and used to develop teaching products such as teaching materials, lesson modules, learning videos, and teaching media (Branch, 2009; Gusmida & Islami, 2017; Sari & Sakdiah, 2016). The following is the flowchart of the ADDIE model.



Figure 1. ADDIE Model (Branch, 2009)

The Analysis stage contains the analysis of mathematics learning problems, especially on the materials of least common multiple and greatest common divisors in elementary schools, analysis of competencies, characteristics, students, and materials. The Planning stage includes determining for whom the research is conducted, the achievement of student competencies, and what strategies should be used so that the subject matter can be well studied. The planning stage also explains the design of student evaluations of Dakon Koper media used in mathematics learning.

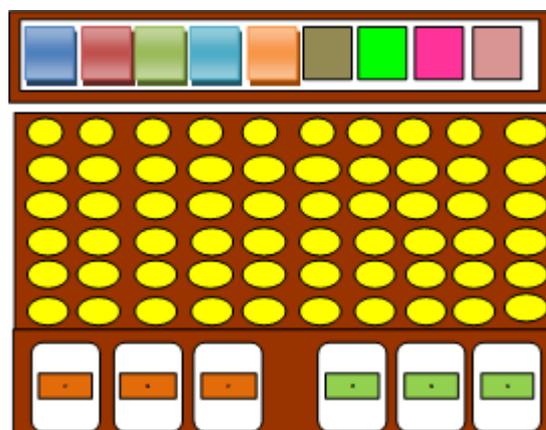
The frame of the Dakon suitcase is a rectangular wooden board measuring 80 x 50 x 7 cm. The suitcase can be opened into two parts, like opening a door. There are hinges to open and close the doors. The cover display has extensive writing and an illustration of a teacher explaining the learning material. Dakon Koper consists of three parts: the first part contains the Dakon container and the number on each container. The second part contains a board to write down the numbers to be looked for in the greatest common divisor and least common multiple. The third part, which is the lower part, contains a container for the blue, pink, and green beads. These colors become the object to fill the dakon according to the number.

In the development phase, Dakon Koper learning media was developed following the plans. The media was then tested through a validation stage by the validators. There were three validators whose tasks were to test the media's validity, namely the material expert, the media expert, and the learning expert (Creswell, 2014). In evaluating the validity, the validators assessed it by giving suggestions and comments that would be used to improve the learning media. Then, the learning media's improvement was constructed based on the validators' suggestions, and revisions

became a prototype for product implementation.

At the implementation stage, the results of the development were implemented in the learning. The evaluation stage was a formative evaluation carried out by collecting data during the development process. In determining the validity of the product, the types of data used were qualitative and quantitative data. Qualitative data were obtained from the input and criticism from media experts and observation and interviews. The quantitative data were derived from analyzing the results from the validation of the material, media, and learning experts and students' responses.

This research was conducted in five elementary schools in Malang city and regency, namely SD Muhammadiyah 9, SD Muhammadiyah 8 KH. Mas Mansur, SD Negeri 5 Mojolangu, and SD Muhammadiyah 8 Dau. The school was selected by random sampling with the boundaries representing public and private elementary schools within Malang. The subjects of this study were 189 students. The following is the Dakon Suitcase media design.



**Figure 2.** The Initial Design of Dakon Koper

Data collection techniques were in the form of observations conducted twice, when determining the needs analysis and when implementing the Dakon Koper

media. Meanwhile, the interviews were conducted in two sessions according to the observations. Other data were gathered in photo documentation and questionnaires containing validation sheets of media experts, material experts, learning experts, and students' questionnaire responses. The data analysis technique was qualitatively gained from the observations, interviews, suggestions, and criticisms from validators. The quantitative data analysis was also obtained from assessments by the validators. The evaluation results of the validation questionnaire were calculated using a Likert scale. The assessment of the results of the students' questionnaire responses was recorded using the Guttman scale with the same formula as follows.

$$P = \frac{\sum x}{\sum xi} \times 100 \%$$

## RESULT AND DISCUSSION

Mathematics learning is incorporated into a teaching and learning process. The process has two kinds of activities that cannot be separated, namely learning and teaching. These learning and teaching aspects become activities that foster relationships between teachers and students, students and students, and students with the environment. This is important to motivate mutual learning (Ambrose, 2004; Godino et al., 2011).

The results showed that classical methods dominated the classroom's mathematics learning process from previous observations and interviews. The teacher gave the material using the lecturing method and question and answer sessions. The teacher also encouraged a group work system or group discussion in working on assignments to not feel bored during the learning process. From the assessment of learning media, it was found that the teachers used textbooks as teaching materials. Sometimes videos were used to help the learning process.

However, the learning videos' use was ineffective and had a less active influence on students. The students would only see and write down important things from the learning videos or even got distracted by non-learning videos. If the teachers designed media, usually they only utilized cardboard with the concept of sticking or matching. The media was mostly used once.

To foster students' learning activity, the teachers must provide a forum for students to explore their understanding through activities carried out by themselves. Mathematics learning is instilling learning experiences by carrying out activities that contain plans to gain mathematics knowledge properly (Ambrose, 2004; Schmidt, 2004). If this process is done, the learning can achieve maximum goals. Learning media can be a supporter of teachers to provide practical planning activities where students can actively argue. Ambrose (2004) and Khairiyah (2019) states that learning media is a useful tool to deliver messages from well-designed sources so that they can form conducive learning activities for the learning process to run efficiently and effectively.

The analysis stage revealed that the students were very active and curious. However, due to the lack of support systems to develop the knowledge, they became inactive in learning. When they felt less motivated and bored, they would occupy themselves and no longer understand the materials. Even though the least common multiple and greatest common divisor material do not have such a complicated formula, the students did not have the spirit or motivation to learn. The researchers also analyzed the competencies, characteristics, and materials. The competency analysis was the basic competency used based on Permendikbud No. 24, 2016. The characteristics analysis showed that the students were very active, always wanted to know, and tried new things. However,

the fourth-grade students can be bored easily. If the learning does not involve the students, they started not to pay attention. A competitive game is an exciting learning element. The analysis of the material affirmed the least common multiple and greatest common divisors.

The media planning stage explained Dakon Koper's media design procedures. As stated by Godino et al. (2011), this stage contains the planning and projecting about who would be the users of the product and the capabilities needed to be achieved. There were four reference steps (Ekowati & Suwandayani, 2020). First, the target of this media design was the fourth-grade students of SDN Mojolangu 5 Malang. Secondly, the competencies to be achieved were students' ability to mention the visibility and factors of a number. Also, the students could understand the initial concepts of the least common multiple and greatest common divisor material, and they could complete practice questions properly without reversing the results. The third was the strategy in implementing learning media, namely by implementing student-centered learning. Here, students use the media and present the results of the use of media. Fourth, the evaluation used by researchers to determine the attractiveness and usefulness of the media. The cognitive aspects were evaluated from how they works on their worksheets. In the affective aspect, the evaluation was done based on students' attitudes in working together and presenting in front of the class. The psychomotor aspect was seen from whether students used Dakon Koper media under the provided guidebook.

The researchers designed the media based on the needs analysis. Dakon Koper media had been carefully designed according to the characteristics of the fourth-grade students. Dakon Koper media is used for learning the least common multiple and greatest common divisor material. The media contained 60 circles. Since this media was developed

for the inculcation of concepts, it still used simple numbers. The media was made following the designed prototype. This media measuring 80 x 50 x 7 cm was conceptualized like a suitcase frame operated by opening a two-door cabinet. This suitcase was made of sturdy woods. There were round beads and pyramid beads used as objects in calculating the least common multiple and greatest common divisor. The round beads were used to calculate the least common multiple numbers, while pyramid beads were used to calculate the greatest common divisor numbers.

At the development stage, the researchers created and developed Dakon Koper media. After the media was ready, the next step was the expert validation. Validation is an essential element in developing media (Aththibby, 2015). It is needed to test whether a product is suitable for use. After the media had been made, the researchers wrote a usage manual. The manual explained the procedures for using the media so that students can easily follow the rules. In the guide book, there was a summary of the material to understand the material and use it in their learning activities. The guide book also contained a collection of the least common multiple and greatest common divisor questions for students. After the media and the guidebook had been constructed, the validation was performed. The media expert validation was carried out in two stages. In the first stage, the media got a percentage score of 95 % with the revision to add the multiplication table. It was suggested for the guidebook to using simple language and be given a picture description to understand the material concept easily. After making revisions, the media was revalidated and got a percentage score of 98 % within the highly feasible category.

Furthermore, the material expert validation obtained a percentage of 95 % within the highly feasible category. The third validation was the learning expert

validation conducted by the fourth-grade teacher. The material expert validation obtained a percentage score of 92 % within the highly feasible category. The following is the visual of Dakon Koper media that has been made according to the prototype design.



**Figure 3.** Dakon Koper Media

According to Sugiyono (2015) the implementation stage is implementing media to determine its effects on the quality of learning. At this stage, the attractiveness and usefulness of the learning media were determined. The research was carried out in January 2020. The learning process was carried out following the prepared lesson plans. The learning was conducted in three core activities. The learning was done with a group work system. The first was the opening activity by playing the game "*oh kelipatan*". In this game, students were trained to focus more. The second game was called "*siapa cepat dia dapat*"; in this game, if the teacher mentioned one question, each group had to compete to raise their hands to answer using the Dakon Koper media. If the answer is correct, the group will get points. When one group answers a question, the other groups must also work on the same problem so that the class would be in a conducive situation. The third game was an evaluation game. The teacher allocated 15 minutes for each group to work on the questions in the guidebook. Each group had to answer as many questions as possible. The group that solved the most

and correctly received the highest points. Of the three activities, the teacher focused more on students' competitive characteristics to keep trying to win the competition in an excellent and sportive manner.

Few findings were obtained based on mathematics learning implementation. The new findings came from students, where they were active in learning because the learning was conceptualized like a game. Game-based media had been successful in fostering students' learning motivation. Dakon Koper made the students solve mathematical questions provided. The media effectively grew students' enthusiasm for working collaboratively between groups because the game has challenged the spirit of competition between groups to get the most points. The competitive game stimulated more sense of cooperation and enthusiasm to win the competition. Dakon Koper media created a fun learning where students sit quietly listening and actively participate directly to build their knowledge. Students can also obtain new experiences and develop their creativity about various media that can be used in learning.

Formative evaluations were chosen in the media evaluation stage. Formative evaluation is utilized to improve a learning media (Hartshorn & Boren, 1990; Sugiyono, 2015). A formative evaluation was used at every step of development, such as validating media experts, material experts, and learning experts. The results were used to perfect the learning media. The criticism and suggestions obtained were used to improve the media to produce a feasible learning media. This evaluation covered the results of the ADDIE development stage and the results of validation by several validators. The validation results can be seen in Table 1.

**Table 1.** The Validation Result

Validator	Stages	Percentage	Category
Media	I	95%	Very valid
	II	98%	Very valid
Material	I	95%	Very valid
	I	92%	Very valid

The researchers then processed the data. In the first validation stage, the developed media obtained a percentage score of 95 % within the very valid category. However, during the second validation stage, the media were revised based on the advice given. After the media was revised, the second validation stage obtained 98 % within the very valid category. Afterward, the researchers validated the media to the material expert and got a percentage score of 95 % within a very valid category without revision. The third validation was from the learning expert. The developed media obtained a percentage of 92 % within a very valid category without revision. The advantages of Dakon Koper are that it is easy to use, concrete, and can help the student to learn mathematics.

## CONCLUSION

Based on the study results and discussion, it can be concluded that the Dakon Koper media is appropriate to be used. The experts' validation assessment results support the Dakon Koper media to be used and implemented in the mathematics learning of least common multiple and greatest common divisor materials for the fourth-grade elementary school students. There was an increase in students' competence in learning by using Dakon Koper media, such as (1) students actively participate in learning, (2) students grow their motivation to try solving problems using Dakon Koper media, (3) the emergence of a sense of enthusiasm and cooperation between students in groups to compete in learning.

Based on the results and discussion, it is suggested that (1) it is necessary to develop a more efficient learning media in terms of time and cost in mathematics

learning, (2) further development can be done to make Dakon Koper media with smaller and lighter sizes, and (3) further researchers may conduct experimental research using Dakon Koper media.

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