Improving Students' Mathematics Learning Outcomes Through The Application of Matrix Domino Card Media

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ARTICLE'S INFORMATION

ABSTRACT

This study was motivated by the low mathematics learning outcomes of SMK Negeri 1 Bayah students. It is necessary to apply learning media that helps improve students' abilities. One of the learning media used is the Domino Matrix Card. This study aims to determine the learning outcomes of students who received treatment using matrix domino cards compared to students who were not given the treatment of learning using matrix dominoes. The results showed that the learning outcomes of students who were treated using matrix domino card media were higher than the learning outcomes of students without using matrix domino card media. The results of the statistical test showed that the learning interest of students utilising the matrix domino card media in the experimental class obtained an average = 67.78 and standard deviation = 20.88 while learning without using the matrix domino card media in the experimental class obtained the average data of students' learning interest = 49.72 and standard deviation = 15.48. After the t-test obtained the results that t count > t-table, which is 1.80> 0.354, the results of hypothesis testing obtained are t count > t-table, then Ha is accepted, meaning that there is an increase in student learning outcomes using matrix domino card learning media in class XI SMKN 1 Bayah 2019/2020 academic year.

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INTRODUCTION

Mathematics is one of the subjects taught from elementary school to university. This shows how important the role of mathematics is in education. Mathematics provides an essential knowledge base for various other fields of science, such as physics, chemistry, and economics, and trains logical and critical thinking skills needed in everyday life. In addition, the ability to solve mathematical problems can help learners in facing challenges in various situations, both in academic and non-academic contexts. Maths also play an important role in developing technology and innovation, which is key to a nation's progress. With a good mastery of mathematics, learners can be better prepared to face the rapid and complex technological developments in today's digital era. Effective mathematics education can shape a young generation that is not only academically smart but also creative and innovative in solving various problems. Therefore, it is important for the education system to continuously improve the quality of mathematics teaching, from teaching methods to the use of interesting and interactive learning media. Using technology in learning mathematics, such as educational software and digital teaching aids, can help make lessons more interesting and easily understood by learners. Maths teaches perseverance and accuracy, as many concepts and formulas require deep understanding and repeated practice. Thus, mathematics provides intellectual benefits and shapes learners' characters to be more disciplined and diligent. Efforts to improve learners'

interest and ability in mathematics must continue so that they can reach their full potential and contribute to advancing science and technology in the future.

Mathematics comes from the root word mathema, meaning knowledge, and mathanein, meaning thinking or learning. In the Indonesian dictionary, mathematics is defined as the science of numbers, the relationship between numbers and operational procedures used in solving problems regarding numbers [1]. Indonesia is a country rich in natural resources; however, the ability of Indonesian children to study mathematics is still very low. The Centre for Educational Assessment of the Ministry of Education and Culture of the Republic of Indonesia states that Indonesia is among the countries with low student achievement. Students' low achievement is partly due to the low quality of education. This can be seen from the fact that the PISA 2015 results show that Indonesian students' ability to understand science issues is ranked 64th, reading skills are ranked 66th and mathematics skills are ranked 65th out of 72 OECD participating countries.

According to [2], the factors that influence students' learning outcomes are internal factors from within students, such as learning motivation, interest, attention, and students' attitudes. High learning motivation encourages learners to be more diligent and enthusiastic in facing every academic challenge. Interest in certain subjects is also decisive because great interest is usually followed by more effort to understand the material. Focused attention during the learning process also plays an important role in achieving optimal learning outcomes. A positive attitude towards the subject and teacher can also increase learning effectiveness, as open and enthusiastic learners tend to be more receptive to the material.

External factors outside the learners include family, school and community environment factors. The family environment is very influential, especially the role of parents in providing support and attention to children's education. Parents who are actively involved in their children's education, for example, by monitoring academic development and providing tutoring at home, can improve children's learning outcomes. In addition, a conducive home atmosphere and adequate learning facilities, such as a study table and reference books, can also support the learning process.

The school environment is also a significant external factor. The way teachers teach, the learning methods used, and the interaction between teachers and learners determine the quality of learning. Teachers who create a pleasant learning atmosphere and motivate students can increase interest and learning outcomes. In addition, the availability of adequate school facilities, such as comfortable classrooms, a complete library, and relevant teaching aids, also supports the teaching and learning process. Good relationships between learners and their peers can create a positive and collaborative learning environment.

The community environment is no less important in influencing students' learning outcomes. A safe and comfortable living environment is very supportive of learning concentration. In addition, access to extensive learning resources, such as public libraries, the Internet, and other educational venues, allows learners to expand their knowledge and skills. Support from the surrounding community, such as participation in academic activities and socialisation that supports education, can also increase learning motivation.

Family socio-economic factors can also affect learners' learning outcomes. Families with good economic conditions can usually provide more complete and supportive learning facilities, such as computers, internet access, and additional tutoring. Conversely, financial limitations can be an obstacle to providing adequate learning facilities. However, these barriers can be minimised with the right strategies and support from various parties. Integrating these internal and external factors is

crucial to creating an optimal learning environment that supports learners' overall academic development. Learning outcomes will continuously improve by understanding and managing these factors.

One of the factors for students' low mathematics learning outcomes is the lack of use of learning media. Creative use of media can facilitate and improve learning efficiency so that learning objectives, namely achieving learning outcomes that meet KKM, can be achieved. [3]. Using appropriate learning media will interest students in mathematics lessons because learning media in suitable teaching aids, such as concrete objects, can attract students' interest in learning. Teachers need media that can facilitate and attract students' interest in learning activities. (Asmarani, Zahroh, & Dewanti, 2022).. Teachers must provide teaching aids as tools in mathematics lessons so that mathematics learning becomes more interesting, which is initially considered difficult, and will become easier to understand. Students who are interested in learning mathematics will be more interested in learning mathematics to improve their learning outcomes.

The word media comes from Latin, the plural "medium". The word means intermediary or messenger from the sender to the message's recipient. The media is very important in the learning process to achieve the expected learning objectives. The media can be in the form of electronic media or media props that are physically used in the learning process. Media functions and regulates the effective relationship between teachers and students to achieve learning objectives. Media is an inherent or inseparable part of the learning process to achieve learning goals. Media functions and plays a role in regulating the effective relationship between teachers and students in the learning process. Learning media includes tools that are physically used to convey the content of learning materials [5].

Learning media plays a very important role in supporting learners' understanding of the material in the teaching and learning process. For example, visual media such as images, graphics, and videos can help learners understand abstract concepts more easily. Visual media allows learners to see concrete representations of concepts that may be difficult to understand through text alone. In addition, audio and audiovisual media can also increase learners' interest and engagement in the lesson. Sound, music and sound effects in audio media can make the subject matter more vivid and interesting, making learners more motivated to learn.

Audiovisual media, which combines visual and audio elements, such as learning videos and animations, can provide a richer and more immersive learning experience. For example, video demonstrations of science experiments can show processes and outcomes that may be difficult or dangerous in the classroom. Thus, learners can understand concepts more tangibly without risk. Interactive media, such as simulations and educational games, also allows learners to participate actively in the learning process. They can try out different scenarios, make mistakes, and learn from the experience in a fun and safe way.

Choosing the right media is crucial to creating effective and enjoyable learning. Media that suit learners' learning styles, visual, auditory or kinesthetic, can help them understand the material in the most natural way. In addition, varied learning media can prevent boredom and increase learners' interest. With increasingly sophisticated digital technology, teachers have access to various types of learning media that can be customised to the needs and characteristics of learners. Digital media such as educational apps, e-learning platforms and virtual teaching aids enable more flexible learning that can be accessed anytime and anywhere.

Effective use of learning media can also support differentiation in teaching, where teachers can

tailor learning materials and methods to the individual needs of learners. This is particularly important in heterogeneous classroom contexts, where learners' abilities and learning styles vary widely. Using the right media, teachers can provide appropriate challenges for learners who grasp the material more quickly and support those who need more help.

Overall, learning media functions as a teaching aid and a means to improve the quality of interaction between teachers and students. By utilising innovative and creative learning media, the teaching and learning process can become more dynamic, interesting and effective, improving students' learning outcomes.

Learning outcomes are the results obtained by students to explore their physical and mental abilities, which are usually stated in the learning outcomes report. The problem researchers found is students' low learning outcomes in completing matrix operations. The teacher does not use learning media during the learning process, so learning becomes less interesting and fun. One of the efforts that can be made is to include subject matter in a game atmosphere. Many types of learning media in a game atmosphere can be used to present the material so that learning looks interesting, one of which is to use domino card learning media in learning matrices. The author calls it Kado Matrix (Domino Matrix card).

The dominoes used in this lesson are not the dominoes that are usually used. However, the dominoes in question have been modified or made by researchers by replacing domino elements in general with matrix material or numbers.

In this study, researchers prepared five sets of domino cards that had previously been modified. The images on the cards were replaced with the matrix material or questions and answers, and the first card side contained questions with answers on the other side of the card so that when played, it would be a series. This matrix domino card can optimise student learning because it is done while playing, so students will be more enthusiastic about following the teaching presented by the teacher.

The use of domino cards in learning has previously been carried out in research conducted by [6], namely the development of domino cards as accounting learning media on the material of the adjusting journal paragraph with the results of the feasibility percentage (82.46%) with a very feasible category and a very good student response with a percentage of (95.4%).

Using the Kado Matrix is expected to improve students' mathematics learning outcomes and increase their motivation and interest in learning. With a fun and interactive learning atmosphere, students can more easily understand the material. In addition, through the matrix domino card game, students can learn to work with their friends to improve their social skills. Therefore, the application of teaching media such as Kado Matrix is useful in improving academic achievement and shaping the character of better learners.

Kado Matrix can be used as a learning media to attract students' attention. According to [7], a maths dominoes card is designed to resemble a dominoes. Maths dominoes contain various pairs of questions and answers. As for the material, it can be adjusted as needed.

In addition, implementing Kado Matrix media also encourages a more competitive yet healthy learning atmosphere among learners. Through domino card games containing matrix problems, learners are indirectly trained to think critically and quickly when answering questions. This helps understand concepts and develop other cognitive skills, such as analysis and problem-solving.

Learning methods that involve games, such as Kado Matrix, also facilitate experiential learning. Learners can directly apply mathematical concepts in the context of games, which makes learning more contextual and relevant to their daily lives. Thus, the material taught becomes a theory and

practice they can understand and apply.

In the long run, innovative learning media such as Kado Matrix are expected to increase learners' interest in mathematics. This increased interest is very important because it can encourage learners to continue learning and exploring more in mathematics, improving their overall academic performance.

Overall, integrating Kado Matrix as a learning medium in mathematics offers many benefits, such as improving learning outcomes and developing students' character. Therefore, educators need to continue to seek and develop innovative and creative learning methods to improve the quality of education in Indonesia.

METHODS

The type of research used this time is a quasi-experiment, which is carried out to determine whether or not there is an increase or the effect of something that is caused in students. This research was conducted at SMK Negeri 1 Bayah, which involved two different classes called experimental and control classes. The first class, XI OTKP 1 class, was the experimental class, and the second class, XI OTKP 2 class, was the control class. Before experimenting, the study was explained to both classes, and consent was obtained from all participants.

Before getting treatment, students are given a pretest (initial test) in the experimental and control classes to equalise students' initial ability. The pretest consisted of questions covering the mathematics topics that will be taught during the experiment. After both classes were given a pretest (initial test), then both classes were given treatment. The experimental class was given treatment using Kado Matrix learning media, and the control class was given treatment without using Kado Matrix learning media. In the control class, the steps were similar, but the teacher did not use the Kado Matrix learning media during the presentation and practice stages. Instead, traditional teaching methods were employed.

This treatment was given twice at meetings in each class, namely in the experimental and control classes. After both classes received treatment, students were given a post-test (final test) to determine each student's mathematics learning ability by using learning media in the experimental class and learning without using learning media in the control class. A pretest was given at the first meeting for the experimental and control classes to determine the student's initial ability. The experimental class was treated using Kado Matrix learning media and ended with a post-test to assess students' learning outcomes. In contrast, the control class was given treatment without using learning media and then finished with a post-test.

RESULTS AND DISCUSSION

Kado Matrix is made just like ordinary dominoes. Only the components or elements are replaced with matrix material or numbers. Dominoes can be made using MS Word application, printed using Concord paper, and cut according to size 3 × 7 cm. This Kado Matrix Media works as follows.
1. Learners are divided into five groups of 6.
2. Each group is given 1 set of the same dominoes
3. Each group is allowed to arrange dominoes according to the time limit given by the teacher.
4. Each group is required to pair the question side with the answer side in the Kado Matrix.
5. The group that is the fastest and most precise in arranging the Kado Matrix is the winning group.

The mean, standard deviation, variance, minimum, and maximum values are obtained from the post-test results of this learning outcome.

Table 1. Post-test Data of Students' Learning Outcomes

No.	Statistics	Experiment Class	Control Class
1	N	18	18
2	Total Value	1220	895
3	Minimum Value	30	20
4	Maximum Value	95	75
5	Average	67,78	49,72
6	Std.Deviation	20,88	15,48
7	Variance	435,95	239,62

Based on the table above, we can see that the learning outcomes of students began to increase, starting from the average value, the maximum number of values, to the minimum value, so that there was a significant increase between the learning outcomes of students who used Kado Matrix learning media with students who were not treated using Kado Matrix learning media. So, the learning outcomes of students who use Kado Matrix learning media are better than classes that do not use Kado Matrix learning media. This can be seen in the picture below.
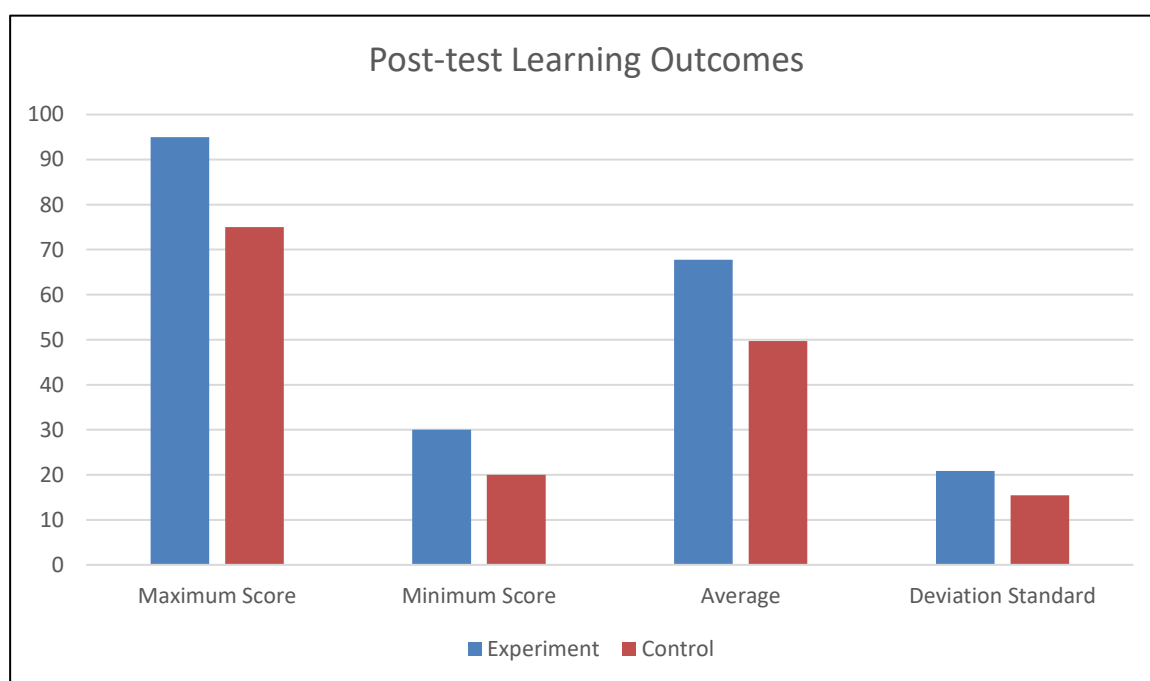

Figure 1. Post-Test of Students' Learning Outcomes

According to [8], teachers' use of appropriate learning media will affect student learning outcomes. Learning media is useful for assisting teachers in delivering material and aims to make it easier for students to receive material offered by the teacher. When students can obtain material well, it will spur their enthusiasm to be more active in learning, resulting in better student learning outcomes. The right learning media can also accommodate various learning styles of students, be it visual, auditory, or kinesthetic, so that each student can learn most effectively. In addition, the use of varied learning media can prevent boredom and increase learners' involvement in the teaching and learning process.

Furthermore, interactive learning media, such as educational games and simulations, can make learning more interesting and fun. This is important because a positive and fun learning atmosphere can increase learners' motivation and interest. Interactive media also allows learners to learn through hands-on practice, which can strengthen their understanding of the material being learnt. For example, in maths learning, the use of props and maths games can help learners understand abstract concepts in a more concrete and fun way.

Using technology in learning media also has great potential in improving learners' learning outcomes. Learning apps, e-learning platforms and videos are technologies that can make learning more engaging and effective. These technologies also enable learners to learn independently outside of school hours, allowing them to organise their learning time according to their needs. With easier access to various learning resources, learners can further deepen their understanding and explore the subject matter.

In addition, the right learning media can also help learners overcome learning barriers. For example, learners with specific learning difficulties can receive teaching media tailored to their needs to follow the learning more effectively. Teachers can also use learning media to provide more immediate and specific feedback, helping learners understand their mistakes and learn from the experience.

Thus, the appropriate use of learning media helps deliver material and plays an important role in creating a supportive and motivating learning environment for learners. Effective learning media can improve the quality of interaction between teachers and learners and between learners and learning materials. Therefore, teachers need to continue exploring and developing innovative and creative learning media to improve overall learner-learning outcomes.

Time management is another crucial factor in the implementation of the learning process. During the study, time management issues were noted, particularly regarding the preparation and execution of activities within the allotted class time. To improve time management, several strategies can be employed.

1. Detailed Lesson Planning: Preparing a detailed lesson plan that includes specific time allocations for each activity can help ensure that all planned activities are completed within the class period. This plan should be flexible enough to accommodate any unforeseen delays.

2. Efficient Classroom Management: Implementing efficient classroom management techniques can minimise time wasted on non-instructional activities. Clear instructions and expectations can help students transition smoothly between activities.

3. Use of Timers: Using timers to signal each activity's start and end can help keep the teacher and students on track. This visual or auditory cue can effectively remind us of the limited time available for each task.

4. Preparation of Materials: Ensuring that all materials and resources are prepared and organised before the lesson begins can reduce downtime during the lesson. Teachers should anticipate the materials needed and have them readily accessible.

Improving time management can have a positive impact on learning outcomes. Efficient use of class time allows for more instructional time and better curriculum coverage. It also reduces student frustration and disengagement caused by rushed or incomplete activities. Furthermore, it sets a good example for students, teaching them the importance of time management in their studies.

Kado Matrix learning media is a teaching alternative that can provide a new atmosphere in teaching and learning activities to help improve student learning outcomes. This theory is supported

by several research results conducted [7], which show that the fraction domino card learning media is very feasible to use in terms of media and material, student response and understanding because it shows very good response and understanding. In line with research [9], his study showed a significant effect of using domino card mathematics props on student learning outcomes. Learning outcomes in students taught using domino card mathematics teaching aids are higher than learning outcomes taught using conventional teaching aids. This can be seen from the average mathematics scores in both classes.

In another study conducted [10]. The results showed that the domino card-based mathematics game media developed reached valid criteria on a score of 4. Meanwhile, the media usage trial results reached 91%, meaning the media is very good (practical).

Using Kado Matrix learning media can improve students' interest and learning outcomes. Based on the study results and the data obtained after being given different learning, the average post-test score of students was 67.78 for the experimental class (Kado Matrix) and 49.72 for the control class (without Kado Matrix).

When viewed from the data analysis of students' mathematics results obtained by researchers in both samples, it can be seen that the average post-test score for the experimental class is higher than the average post-test score of the control class. In this case, the Kado Matrix learning media has a better impact. Still, researchers need a little longer learning time, students tend not to want to learn in groups, and researchers need a lot of preparation (material, funds, and energy).

This is also because in the learning process using Kado Matrix media, students are invited to work together in finding pairs on other domino cards, and students are directed to be more active in discussing, asking questions, and looking for answers. With learning using this Kado Matrix media, it can be said that learning is centred on students, where students are the ones who try to find answers to the dominoes they have. Compared to learning without Kado Matrix, learning is teacher-centred, while students only listen to any material presented by the teacher. This causes students to be inactive in following the learning process.

In accordance with the t-test rules, it can be formulated as follows: H0 is rejected if t count ≤ t-table and ha is accepted if t count ≥ t-table. For the results of students' mathematics data, the results obtained that t count > t-table is 1.80> 0.354, the results of hypothesis testing obtained are t count > t-table, so Ha is accepted, meaning that there is an increase in student learning outcomes using Kado Sadrat learning media in class XI SMKN 1 Bayah 2019/2020 academic year.

CONCLUSIONS AND SUGGESTIONS

From the data analysis conducted by the author, it can be concluded that there is an increase in student learning outcomes using Kado Matrix media. The development of media in the form of cards containing matrix material limited to matrix addition and multiplication operations has two parts: one side contains questions, and one side includes answers paired with other cards so that they become a series. Based on the results of this media development, it is necessary to develop this domino card media with more diverse matrix material or other questions on matrix material or other subjects.

Recommendations based on the research results obtained are as follows.

1. Teachers can use the Kado Matrix media more effectively by integrating it with small group discussion strategies. Teachers should guide students to solve problems on the domino cards, enhancing students' social and teamwork skills.

2. Teachers need to prepare alternative solutions in case of technical or logistical challenges in using this media, such as the limited number of cards or insufficient time. Providing a digital version of the domino cards can be one solution to overcome these obstacles.

3. Teachers must conduct brief training or workshops on using the Kado Matrix media for their fellow teachers. This ensures that all teachers can apply this media correctly and effectively in their classrooms.

4. Another potential challenge is the varying levels of students' understanding of the material presented through this media. Teachers should prepare additional questions with differing levels of difficulty to accommodate students with different abilities.

Moreover, teachers should be ready to provide additional guidance to students who have difficulty understanding the material through the Kado Matrix media. This guidance can be provided through tutoring sessions or individual consultations outside class hours.

This domino card with matrix material or other diverse questions on matrix material or other materials. In addition to developing this domino card game, it is possible to develop other media so that learning is not monotonous and only focuses on the teacher.

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