Analysis of Microsoft Mathematics's Use in Mathematics Learning: A Case Study on Matrix Multiplication and Determinants

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Abstract

This study aims to determine the impact of using Microsoft Mathematics application on students' concept understanding ability in multiplying two matrices and determining matrix determinant. This type of research is qualitative research with a case study approach. This research was conducted in one of the state high schools in Kolaka in class XI IPA. The number of subjects in this study were 3 students. Data collection techniques in this study were using tests and interviews to determine students' understanding of the concept of multiplication of two matrices and the concept of determinant. The results of this study are students who previously did not understand well related to the concept of multiplying two matrices, but after using the microsof mathematics application understand well related to the concept of multiplying two matrices and when the two matrices can be multiplied. In addition, students also understand well the procedures and concepts in determining the determinant of the matrix. Therefore, Microsoft Mathematics application is highly recommended to be used by teachers in introducing the concept of multiplication of two matrices and the concept in determining the determinant of the matrix.

Keywords: *Matrix; Microsoft Mathematics; Concept Understanding.*

Abstrak

Penelitian ini bertujuan untuk mengetahui bagaimana dampak penggunaan aplikasi microsoft mathematics terhadap kemampuan pemahaman konsep siswa dalam mengalikan dua buah matriks dan menentukan determinan matriks. Jenis penelitian ini adalah penelitian kualitatif dengan pendekatan studi kasus. Penelitian ini dilakukan disalah satu sekolah SMA Negeri di Kolaka pada kelas XI IPA. Adapun jumlah subjek pada penelitian ini adalah 3 orang siswa. Teknik pengumpulan data pada penelitian ini yaitu dengan menggunakan test dan wawancara. Adapun hasil dari penelitian ini yaitu siswa yang sebelumnya belum paham dengan baik terkait konsep perkalian dua buah matriks, namun setelah menggunakan aplikasi microsof mathematics memahami dengan baik terkait konsep perkalian dua buah matriks dan kapan kedua buah matriks dapat dikalikan. Selain itu siswa juga mehamami dengan baik prosedur dan konsep dalam menentukan determinan matriks. Oleh karena itu, aplikasi microsoft mathematics sangat direkomendasikan untuk digunakan oleh guru dalam memperkenalkan konsep perkalian dua buah matriks dan konsep dalam menentukan determinan matriks.

Kata Kunci: Matriks; Microsoft Mathematics; Pemahaman Konsep.

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INTRODUCTION

One of the important skills in mathematics learning is understanding the concepts being taught. This involves the ability to demonstrate understanding of the mathematical concepts being studied, explain the relationships between those concepts, and apply concepts or algorithms flexibly, accurately, efficiently, and appropriately when solving problems. According to (NCTM, 2000), for students to achieve a deep mathematical understanding, mathematics education must aim to develop their ability to connect various mathematical ideas, understand the relationships between mathematical concepts to form a comprehensive understanding, and apply mathematics in contexts outside the field of mathematics. One of the mathematical topics that students need to understand well is the concept of matrices.

Matrices is one of the subjects taught at the high school level, specifically in the 11th grade. Students often make mistakes when solving problems related to matrices. The common errors made by students in matrix operations are during the multiplication of two matrices and determining the determinant of a matrix. This isin line with the research conducted by (Bahar et al., 2022; Wahyuningsi, 2020) which states that many students still make mistakes in solving matrix problems, especiallyin matrix operations. Furthermore, this is also in line with the research conducted by (Prasetyo et al., 2023) which states that many students often make mistakes in determining the operation of two matrices and mistakes in determining the determinant of a matrix.

The causes of students' errors in solving matrix problems are the students' lack of understanding in operating numbers, the lack of understanding of the concept of multiplying two matrices, and the many students who only memorize the determinant formula without a deep understanding. This is in line with the research revealed by (Gustianingum & Kartini, 2021; Nuritasari et al., 2017) that students often make mistakes because they do not have a deep understanding of the concept of matrix multiplication and the concept of determining the determinant, so students only memorize the formulas and are at risk of forgetting them.

Therefore, a solution needs to be considered to address this issue so that students' mistakes can be minimized.

One of the efforts to reduce student errors in solving matrix problems is through the use of the Microsoft Mathematics application. This is in line with the research conducted by (Suryacitra & Oktavia, 2018) which states that the use of Microsoft Mathematics can train students' precision, thereby reducing their mistakes. Additionally, the use of this application also aims to enhance students' interest in learning (Gunawan & Rojali, 2018) and make them more active in participating in lessons, so that every learning process undertaken by students will gain experience and become meaningful learning because students engage with it directly. This is in line with the research conducted by (Yuliandari et al., 2024) which states that when students take an active role in learning, they will better understand the concepts or material being taught, thereby reducing the mistakes that may occur.

In addition, the use of technology in learning can also be utilized by teachers as a tool to help students understand the concepts of the material being taught. The use of the application can serve as scaffolding, which will later be controlled so that students do not become dependent on using the application but instead gain a good understanding from its use. The provision of scaffolding in learning is very important because it can also minimize the mistakes made by students, as the scaffolding is based on the difficulties faced by students in solving the given problems. This is in line with the research conducted by (Hanifah, 2017; Purwasih & Rahmadhani, 2022; Susilowati & Ratu, 2018) which states that providing scaffolding to students in learning can reduce the mistakes made by students.

Therefore, this research aims to determine the impact of using Microsoft Mathematics in mathematics learning. Where the ability measured is the ability to understand the concept of students in multiplying two matrices and determining the determinant of the matrix.

RESEARCH METHODS

This research is qualitative, with a case study approach. This research begins with a literature review related to the theories underlying the use of technology in learning, the structure of the Microsoft Mathematics application, and its use in matrix material. This research aims to examine the use of the Microsoft Mathematics application in mathematics learning on the topic of multiplying two matrices and determining the determinant of a matrix. The subjects of this research are a group of students from one of the public high schools in SMAN 1 Kolaka. The number of subjects in this study is 3 students. This study involved three subjects chosen based on their previous mathematics test scores, reflecting their varying levels of understanding of matrix concepts. The selection criteria ensured diversity in their initial comprehension, allowing the study to examine how the Microsoft Mathematics application affects their grasp of specific topics such as matrix multiplication and determinants. By including students with differing levels of prior knowledge, the research aims to track changes in understanding among both those with limited initial comprehension and those with a foundational grasp. This approach provides a comprehensive perspective on the role of technology in improving students' mathematical understanding. The data collection technique in this study uses tests to determine the extent of students' understanding before and after using the application, and interviews to confirm the understanding gained by students after using the Microsoft Mathematics application. The interview guide used in this study was designed to explore the extent of students' understanding of the mathematical concepts taught, particularly after using the Microsoft Mathematics application. The guide includes a series of questions focusing on two main areas: first, students' understanding of the procedures for multiplying two matrices and the conditions under which the matrices can be multiplied; and second, students' comprehension of the steps involved in determining the determinant of a matrix.

After the researcher selected the subjects for the study, the researcher administered an initial test to determine the extent of the students' conceptual understanding related to matrix multiplication and determinants. After that, the

researcher analyzed the preliminary study results and applied the use of Microsoft Mathematics. The final stage involved administering a follow-up test to determine the extent of the students' mathematical conceptual understanding of matrix material. The indicators of conceptual understanding used by the researcher are: (1) students can restate the concepts learned, (2) students can analyze the properties of the concepts, (3) apply the concepts logically, and (4) provide examples and non-examples.

RESULTS AND DISCUSSION

The following will present the initial findings of the researchers before applying the use of Microsoft Mathematics in solving matrix-related problems.

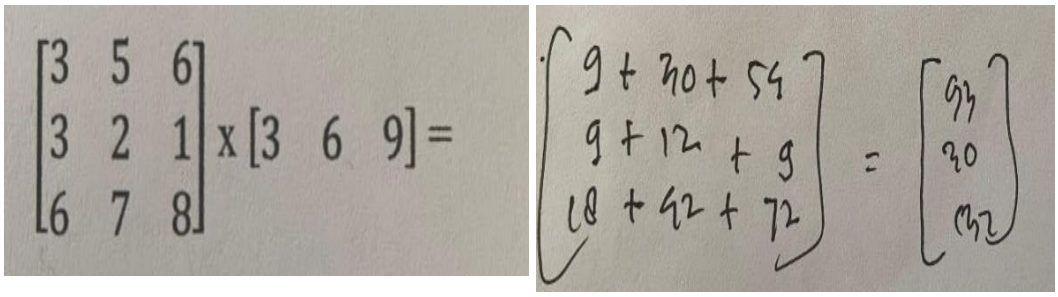

Figure 1. Student's Work Results S1

Based on the image above, it is evident that students do not have a good understanding of the concept of multiplying two matrices because they do not meet the concept comprehension indicators used in this research. Students think that every matrix can be multiplied without considering the size of the rows and columns of both matrices. This needs to be closely monitored so that the mistakes made by the students do not continue to occur. Additionally, errors in solving matrix problems do not only happen in the concept of multiplication but also in the concept of determining the determinant of a matrix.

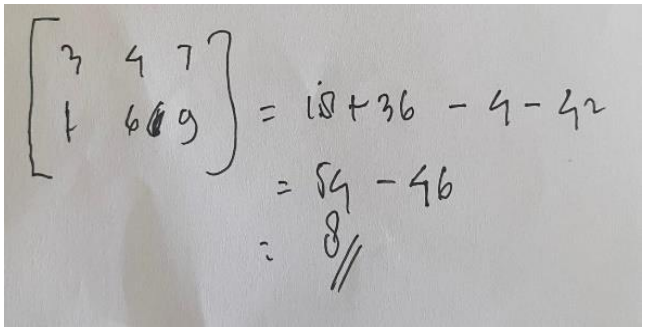

Figure 2. Student's Work Results S1

Figure 2 provides an understanding that students do not yet grasp the concept of determining the determinant of a matrix (applying the concept logically), because students do not pay attention to the size of the given matrix, whether the determinant of the matrix can be determined or not.

Based on the problem, the researcher attempted to use Microsoft Mathematics to understand the concepts and procedures in determining the multiplication of two matrices and the determinant of a matrix. The researcher provided students with the opportunity to explore the multiplication of two matrices first. Then, additional time was given to further explore determining the determinant of a matrix. After using the application, the researcher provided questions as a form of evaluation to measure the extent of the students' understanding post-application.

Here is the trial-and-error process of students to discover the concept of multiplying two matrices.

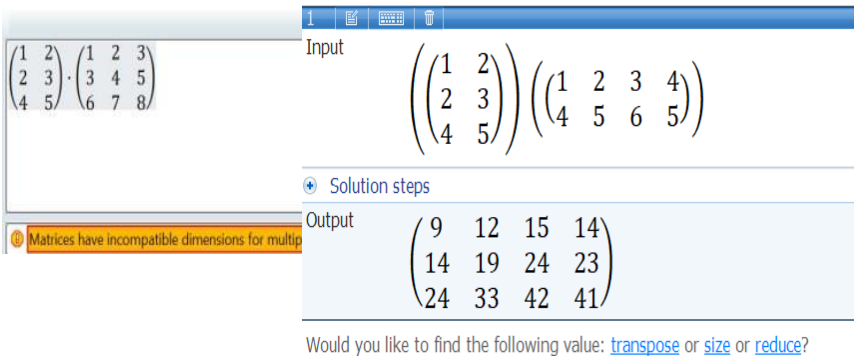

Figure 3. Student's Trial-and-Error Process

After the students conducted the experiment twice, they have discovered the concept of multiplying two matrices. Below are the students' work results along with an interview regarding the understanding gained after using the application.

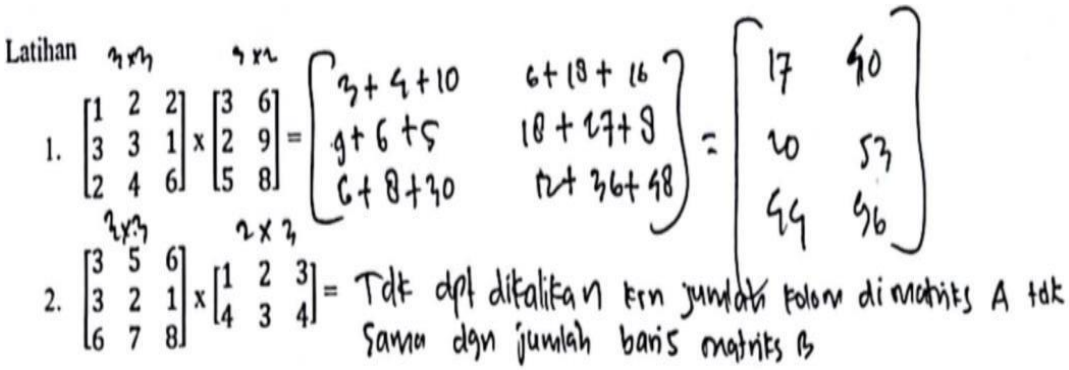

Figure 4. Student's Work Results S1

Based on the image above, it was found that the students have a good understanding of matrix multiplication, which they previously did not know when two matrices could be multiplied. Here are the results of the interview excerpts regarding the students' understanding of the multiplication concept.

P : Why did you multiply the matrices in question number 2 before using the application?
S1 : I didn't know when two matrices can be multiplied, so I just multiplied them directly.
P : What did you understand after using the application?
S1 : Two matrices can be multiplied if the number of columns in the first matrix is equal to the number of rows in the second matrix.
P : How many trials did you perform using the application to gain that understanding?
S1 : Two, Sir.

Based on the interview results above, it was found that after students experimented twice using the application, S1 students could easily understand when two matrices can be multiplied and when two matrices cannot be multiplied. (S1 has met the indicators of conceptual understanding). Therefore, the use of applications in learning can help students understand the concepts of a subject. This

is in line with (Mayasari et al., 2021) who state that using Microsoft Mathematics applications can help students understand the material well and will affect their achievements in learning.

Then other students also experienced a good understanding after using the Microsoft Mathematics application. Here are the results of their work.

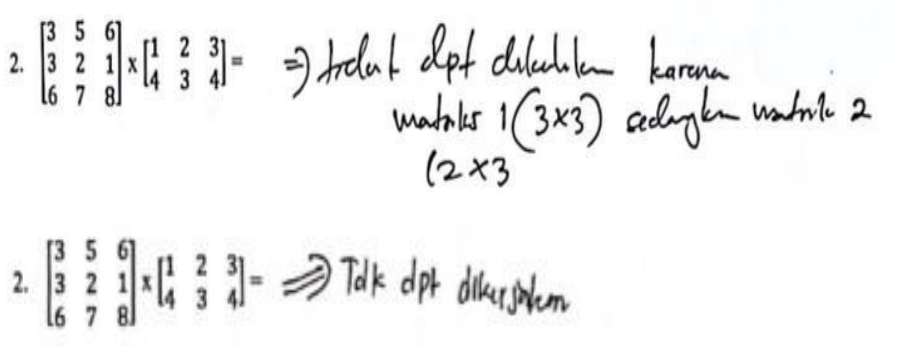

Figure 5. Student's work results S2 and S3

P : Why didn't you multiply the matrices in question number 2 before using the application?
S2 : I didn't know what to do, Sir.
S3 : I was confused, Sir.
P : What did you understand after using the application? Why couldn't question number 2 be solved?
S2 : Two matrices can be multiplied if the number of columns in the first matrix is equal to the number of rows in the second matrix.
S3 : It couldn't be solved because the number of columns in the first matrix is not equal to the number of rows in the second matrix.
P : How many trials did you perform using the application to gain that understanding?
S2 : Three trials, Sir.
S3 : Five trials, Sir.

In addition to understanding students' comprehension of the multiplication of two matrices, this experiment also aims to determine the extent of students' understanding related to calculating the determinant. The following presents the students' work results after using the application. Based on interviews with S2 and S3 students after using the application, although many experiments conducted by the students were different, both students were able to understand

the concept of multiplying two matrices well. Thus, using the application can help studentsunderstand a concept from the material being studied. This is in line with the research conducted by (Mendezabal & Tindowen, 2018)which states that learning using Microsoft Mathematics can help students understand the conceptu al and procedural aspects of the material being studied. Furthermore, this is also consistent with the research conducted by (Ekawati, 2016) which states that the use of ICT- based applications greatly aids students in understanding the material being studied,specifically the Microsoft Mathematics application.

In addition to understanding students' comprehension of the multiplication of two matrices, this experiment also aims to determine the extent of students' understanding related to calculating determinants. The following presents the students' work results after using the Microsoft Mathematics application.

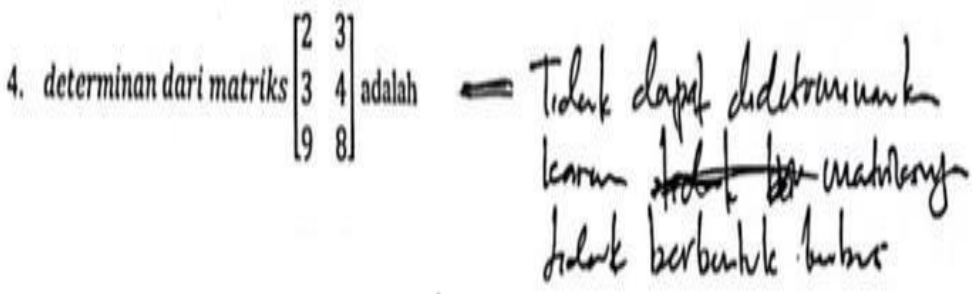

Figure 6. Student's Work Results S2

Based on the results of the S2 student's work, it was found that the student has a good understanding of when a matrix can have its determinant determined. Here are the excerpts from the interview with the master's student.

P : Why didn't you calculate the determinant before using the application?
S2 : I forgot the formula for the determinant of a matrix, Sir.
P : What did you understand after using the application?
S2 : A matrix can have its determinant calculated if it is a square matrix.
P : How many trials did you perform using the application to gain that understanding?
S2 : Three trials, Sir.

Based on the interview results above, it was found that the S2 student has a good understanding of the concept of matrices that can have their determinants determined. The S2 student refers to matrices that can have their determinants determined as cube-shaped matrices. In other words, matrices that are nxn in shape. Furthermore, S1 and S3 students also successfully understood the concept of matrices that can have their determinants determined. Here are the responses from students S1 and S3.

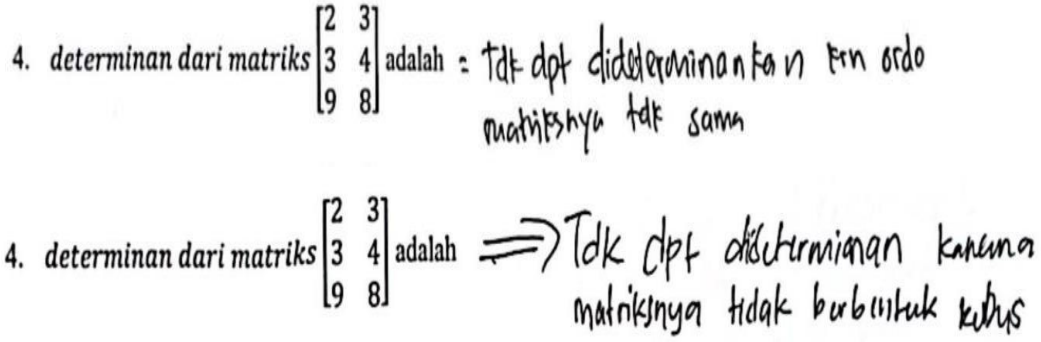

Figure 7. Student's work results S1 and S3

Based on the two images of the work done by the S1 and S3 students, it was found that the students already understand when a matrix can have its determinant determined. To confirm the answer, the following interview was conducted.

P : Why were you able to determine the 3 x 2 matrix before using the application?
S1 : I tried using what I already knew, Sir.
S3 : I didn't work on it, Sir.
P : What did you understand after using the application?
S1 : A matrix can have its determinant calculated if its order is the same.
S3 : A matrix can have its determinant calculated if it is a square matrix.
P : How many trials did you perform using the application to gain that understanding?
S1 : One trial, Sir.
S3 : Four trials, Sir.

The interview excerpt above shows that both students understand well whena matrix can have its determinant determined. Thus, in the given problem, both students did not make repeated mistakes.

Based on the students' work related to solving the multiplication of two matrices and determining the determinant of a matrix, it was found that when students use the Microsoft Mathematics application, they can understand concepts and procedures well. Thus, the use of applications or ICT in learning greatly assists teachers in teaching the material to be taught. The use of applications in learning is very beneficial, in line with the research conducted (Rusmana, 2015; Suratman et al., 2019; Zayyadi et al., 2017) which states that the use of ICT in mathematics learning canhelp students understand the concepts of the material being taught.

Then, the use of applications in mathematics learning can also help eliminate the stigma among students that learning mathematics is very difficult and stressful. This is in line with the statement expressed by (Wangge, 2020) that the use of ICT in learning can make students enjoy learning mathematics, thereby dispelling the notion that mathematics is difficult. Additionally, to address the dependency on application usage in learning, teachers should closely supervise its use. Then, another method that can be employed is for the teacher to ask questions that stimulate students' critical thinking skills to determine the extent of their understanding of the concepts obtained from using the application.

Based on the results of the discussion above, it was found that S1 students were able to understand well related to multiplying two matrices and determining the determinant with the help of Microsoft Mathematics after 2 times of trial, while S2 and S3 students were also able after using the help of Microsoft Mathematics 3-4 times of trial.

CONCLUSION

Microsoft Mathematics is one of the applications that can help students find solutions to mathematical problems, especially in the topic of matrices. In addition to finding the final solution, this application also provides students with an understanding of the concept of matrix multiplication and determining the

determinant of a matrix, along with its procedures. Based on the results of the experiments conducted, it was found that students who previously did not understand the general concept of when two matrices can be multiplied were able to understand it well after using the application. Additionally, students who previously worked on determinant problems that were not of size nxn, after using the application, gained an understanding that the determinant can only be determined for nxn matrices. Therefore, the Microsoft Mathematics application is highly recommended for teachers to use in teaching matrix material, especially during the multiplication of two matrices and determining the determinant of a matrix. However, proper supervision is needed in its use so that students do not become dependent on it.

REFERENCES

Bahar, E. E., Fitriani, F., & Nursakiah, N. (2022). Analisis Kesalahan Siswa Dalam Menyelesaikan Soal Matriks Pada Kelas Xi Sma. *Proximal: Jurnal Penelitian Matematika Dan Pendidikan Matematika*, *6*(1), 25–33. https://doi.org/10.30605/proximal.v6i1.2136

Ekawati, A. (2016). Penggunaan Software Geogebra Dan Microsoft. *Jurnal Pendidikan Matematika*, *2*(3), 148–153.

Gunawan, A. A. S., & Rojali, F. (2018). Meningkatkan Proses Pembelajaran Matematika Dengan Perangkat Lunak Microsoft Mathematics. *Proceedings National Conference on Corporate Social Responsibility*, *1*(1), 7–12.

Gustianingum, R. A., & Kartini, K. (2021). Analisis kesalahan siswa berdasarkan objek matematika menurut soedjadi pada materi determinan dan invers matriks. *Mosharafa*, *10*(2), 235–244.

Hanifah, A. I. (2017). Pemberian Scaffolding untuk Mengatasi Kesalahan Siswa Dalam Menyelesaikan Masalah Matematika. *Reforma: Jurnal Pendidikan Dan Pembelajaran*, *6*(2).

Mayasari, N., Hasanudin, C., Fitrianingsih, A., Jayanti, R., Setyorini, N., Kurniawan, P. Y., & Nurpratiwiningsih, L. (2021). The Use of Microsoft Mathematics Program toward Students' Learning Achievement. *Journal of Physics: Conference Series*, *1764*(1). https://doi.org/10.1088/1742-6596/1764/1/012132

Mendezabal, M. J. N., & Tindowen, D. J. C. (2018). Improving students' attitude, conceptual understanding and procedural skills in differential calculus

through microsoft mathematics. *Journal of Technology and Science Education*, *8*(2), 199–216. https://doi.org/https://doi.org/10.3926/jotse.356

NCTM. (2000). *Principles and Standards for School Mathematics*. https://www.ptonline.com/articles/how-to-get-better-mfi-results

Nuritasari, F., Hasanah, S. I., & Sholehoddin, A. (2017). Analisis Kesalahan Siswa Dalam Menyelesaikan Soal Matematika Pokok Bahasan Matriks Di Kelas Xi Ma. *JP2M (Jurnal Pendidikan Dan Pembelajaran Matematika)*, *3*(2), 108. https://doi.org/10.29100/jp2m.v3i2.1761

Prasetyo, A., Fatah, A., & Novaliyosi, N. (2023). Analisis Kesalahan Siswa Kelas Xi Dalam Menyelesaikan Soal Pemahaman Konsep Matematis Pada Materi Matriks. *Wilangan: Jurnal Inovasi Dan Riset Pendidikan Matematika*, *4*(4), 328–335. http://www.jurnal.untirta.ac.id/index.php/wilangan

Purwasih, S. M., & Rahmadhani, E. (2022). Penerapan Scaffolding Sebagai Solusi Meminimalisir Kesalahan Siswa Dalam Menyelesaikan Masalah Spldv. *FIBONACCI: Jurnal Pendidikan Matematika Dan Matematika*, *7*(2), 91. https://doi.org/10.24853/fbc.7.2.91-98

Rusmana, I. M. (2015). Efektifitas Penggunaan Media ICT dalam Peningkatan Pemahaman Konsep Matematika. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, *2*(3).

Suratman, A., Afyaman, D., & Rakhmasari, R. (2019). Pembelajaran berbasis TIK terhadap hasil belajar matematika dan motivasi belajar matematika siswa. *Jurnal Analisa*, *5*(1), 41–50.

Suryacitra, G. E., & Oktavia, R. (2018). *Pemanfaatan Program Microsoft Mathematics untuk Meningkatkan Ketelitian Siswa Kelas XI dalam Menyelesaikan Soal Perkalian Dua Buah Matriks*.

Susilowati, P. L., & Ratu, N. (2018). Analisis kesalahan siswa berdasarkan tahapan newman dan scaffolding pada materi aritmatika sosial. *Mosharafa: Jurnal Pendidikan Matematika*, *7*(1), 13–24.

Wahyuningsi, D. (2020). Analisis Kesalahan Siswa Dalam Menyelesaikan Soal Pada Materi Operasi Matriks Di Sma Yabt Manokwari. *Jurnal Perspektif Pendidikan*, *14*(2), 67–77. https://doi.org/10.31540/jpp.v14i2.1027

Wangge, M. (2020). Implementasi Media Pembelajaran Berbasis ICT dalam Proses Pembelajaran Matematika di Sekolah Menengah. *Fraktal: Jurnal Matematika Dan Pendidikan Matematika*, *1*(1), 31–38. https://doi.org/10.35508/fractal.v1i1.2793

Yuliandari, R. N., Anggraini, D. M., & Rahmah, U. N. (2024). *Peningkatan Pemahaman Konsep Pecahan Siswa Sekolah Dasar dengan Media Kertas Lipat*. *4*(1), 93–102.

Zayyadi, M., Supardi, L., & Misriyana, S. (2017). Pemanfaatan teknologi komputer sebagai media pembelajaran pada guru matematika. *Jurnal Pengabdian Masyarakat Borneo*, *1*(2), 25–30.