# Matrix Material Learning Design Using Context of Bookshelf to Support High School Students Understand Concepts

Trisna Wulandari[1], Zulkardi[2], Ely Susanti[3*)], Meryansumayeka[4]
[1,2,3,4] Sriwijaya University
*)ely_susanti@fkip.unsri.ac.id

**Abstract**
Understanding concepts is something that students need to have because concepts in mathematics are interrelated with each other. The purpose of this study was to determine the learning design on matrix material using the concept of bookshelves (lockers) that can support the understanding of the matrix concept of high school students. The researcher designed a student activity sheet with the context of bookshelves (lockers) that are often found in the school environment that are used in learning. The subjects of the study were 35 high school students in grade XI at SMA Srijaya Negara Palembang. The research method used was design research through three stages, namely the preparation for the experiment, the design experiment, and retrospective analysis. Data collection through the results of student activity sheets and interviews. The data collected were analyzed descriptively. This study produced *Hypothetical Learning Trajectory* (HLT) which can support student understanding to the concept of matrices.
**Keywords:** Conceptual understanding, learning design, matrix, PMRI

## Introduction

Mathematics is a subject that plays an important and useful role in life as a science that studies how to calculate and measure things with symbols and numbers (Widyastuti et al., 2020). In learning mathematics, understanding concepts is an important part and goal, where understanding here means that students are able to translate, interpret, and conclude a mathematical concept from the knowledge they have (Widyastuti et al., 2020; Yunita Sari et al., 2024).This is in line with previous research that conceptual understanding is an important element in learning mathematics, where having a lot of conceptual mastery will enable individuals to solve problems more effectively by following the rules of the problem concepts they have (Rizka et al., 2024; Wanabuliandari et al., 2023). Understanding mathematical concepts is the first stage as an ability that students must have in order to master other abilities at a higher level (Ostian et al., 2023).

One of the concepts that students need to have in learning mathematics is the concept of matrices. Matrices are one of the mathematical materials that must be mastered by class XI SMA which is part of the high school mathematics education curriculum (Sulistina et al., 2024). Matrix is one of the mathematical materials that is very close to the daily problems of students, especially middle school students and above, such as solving economic problems

that contain various variables, statistics, education, management, technology, and others (Sulistina et al., 2024; Zahara et al., 2020).

However, in reality in the field, the ability to understand concepts in matrix material in high schools is still low, as can be seen from the majority of students saying that the matrix material presented by the teacher is difficult to understand (Zahara et al., 2020). This is because teachers also have difficulty teaching matrix material by presenting contextual problems that are easy for students to understand and imagine, as seen when teachers give matrix problems with different orders from the examples explained, students already find it difficult to determine the elements in the matrix (Zahara et al., 2020). This is in line with previous research that students' mastery of concepts in this matrix material is still relatively low, based on more than 50% of students failing the matrix concept (Sulistina et al., 2024). Difficulty in understanding the concept of matrices often arises because students do not yet have a strong understanding of matrix material, where students experience confusion in identifying rows and columns and arranging matrix elements (Sulistina et al., 2024). Teachers are more accustomed to implementing conventional learning by presenting formulas instantly, making matrix learning uninteresting and difficult for students to understand (Zahara et al., 2020). Students' failure to solve matrix problems is due to errors in the concepts that students have (Sulistina et al., 2024).

Student success in understanding matrix concepts is influenced by learning models and interaction experiences by linking matrix concepts to relevant contexts in various situations (Widyastuti et al., 2020; Sulistina et al., 2024). The mistake that students often make on matrix problems is in applying concepts in solving problems so that a renewal of the learning process is needed (Zahwa, 2023). Therefore, a learning model is needed that can make students interested and confident in learning matrix concepts that can be directly related to real life. One solution that can be used is to design a learning strategy using a real context to support students' in-depth understanding of matrix concepts (Yunita Sari et al., 2024; Sulistina et al., 2024). In this case, the right way for the success of mathematics learning is to support the understanding of the concept of matrices by using the Indonesian Realistic Mathematics Education (PMRI) approach.

Indonesian Realistic Mathematics Education (PMRI) is a learning approach that adapts the theory of mathematics education learning that was developed by Fruedhental, Netherlands (Utari, et al., 2023). The PMRI approach is an approach that allows students to rediscover mathematical concepts with the guidance and support of special teachers followed

by situations in the surrounding environment (Rohmah et al., 2024). PMRI emphasizes the importance of using real contexts in mathematics learning to become a strong foundation in understanding mathematical concepts (Wigati, 2020; Zulkardi et al, 2019). Learning using the PMRI approach begins with a real context in everyday life that bridges the informal stage with the formal stage of mathematics, where the problems given are real experiences that can be imagined in the minds of students (Yunita Sari et al., 2024).

Several previous studies that have compiled matrix material using real contexts include: Astuti (2022) using the context of local wisdom focusing on rice farming, Adityawan et al (2023) using the context of express tickets and arrangement of goods, and Zahwa (2023) uses student worksheets based on philosophy, one of which uses the context of Palembang songket, as well as learning using the PMRI approach byWigati (2020), Zulkardi et al (2019) and Rawani (2023). Based on previous research, the context has a great influence and support for understanding concepts (Rawani, 2023), but there has been no research that designs matrix material learning using the concept of bookshelves (lockers) to support students' understanding of matrix concepts. Bookshelves (lockers) are school furniture that are expected to be available in every class in the form of compartmentalized cabinets for storing books which will make it easier for students to access book collections easily (Siregar et al, 2022; Rohiyatun, 2019). Bookshelves (lockers) are thought to be able to facilitate teachers to direct the concept of matrices to students. This is because bookshelves (lockers) have partitions that separate several spaces that can represent rows and columns in the matrix (Suban et al, 2024). Therefore, this article will specifically discuss how the design of matrix material learning uses the context of bookshelves (lockers) that can support high school students to understand the concept of matrices. The purpose of the research to be carried out is to determine the role of bookshelves (lockers) in understanding concepts in matrix material.

## Method

This research is a qualitative research with a method *design research validation study type.* The subjects of the study consisted of 35 students in grade XI at SMA Srijaya Negara Palembang. The research method used was design research through three stages, namely the preparation for the experiment, the design experiment, and retrospective analysis. In this study, learning activities were designed using contexts that were close to students' daily lives to support students' understanding of the matrix concept. The design

research went through three stages, namely preparing for the experiment, the design of the experiment, and retrospective analysis (Gravemeijer & Cobb, 2006). In summary, the research stages are presented in Figure 1 below.

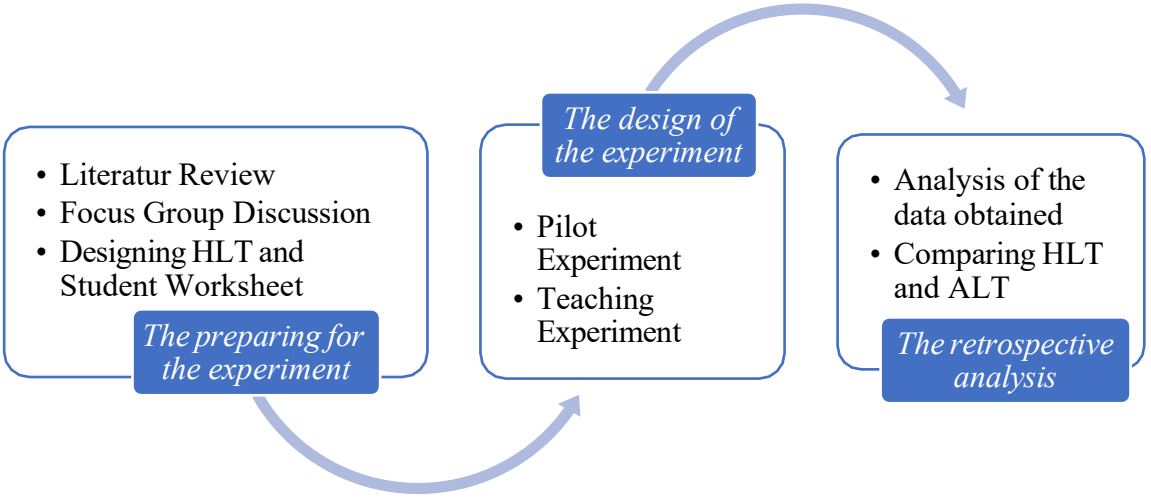


**Figure 1.** Design Research Stages

In the preparation stage, the researcher conducted a literature study related to matrix material, designed student activity sheets, and designed a planning framework in the form of *Hypothetical Learning Trajectory* (HLT) which was developed from student activity sheets through an approach of Indonesian Realistic Mathematics Education (PMRI). HLT contains learning objectives, learning activities that students will do, and assumptions about how students think during learning (Sari, 2024; Ulpa, 2019; ). The experimental design stage is divided into two stages, namely pilot experiment and teaching experiment. In the pilot experiment stage, the researcher tested the HLT that had been designed on a small group and the results were used as revision material to improve the HLT to be better. After *Hypothetical Learning Trajectory* (HLT) was revised and then tested on one of the XI classes at SMA Srijaya Negara Palembang at the teaching experiment stage. The third stage is a retrospective analysis, with this data will be compared the data that has been obtained from the results of the teaching experiment with the HLT that has been designed. Then the results of this HLT are compared with the Actual Learning Trajectory (ALT).

In this study, data collection was carried out by providing Student Activity Sheets (LAS), observation, and interviews. Data collection of student activity sheets was carried out at the trial and teaching trial stages. Observations were carried out during the learning activities. Interviews were conducted to confirm the answers and processes that had been

carried out on the student activity sheets and to obtain additional information that was not obtained during the learning process. The data that had been collected was analyzed using qualitative descriptive techniques.

## Results and Discussion

*Research Preparation Stage*

At the research preparation stage, the researcher conducted a literature review, analysis, and discussion with teachers and lecturers who taught the course, and the researcher designed the Student Activity Sheet (LAS) and *Hypothetical Learning Trajectory* (HLT), which will be used in mathematics learning using the PMRI approach. The HLT design consists of three components: learning goals, learning activities, and hypothetical learning processes/conjectures (Gravemeijer & Cobb, 2006). The designed Hypothetical Learning Trajectory (HLT) is presented in Table 1.

**Table 1.** HLT Design

| **Learning Goal** | **Learning Activities** | **Hypothetical Learning Processes/Conjectures** |
|---|---|---|
| From real problems, students can state data to form a matrix. | 1. Students observe the images and text presented<br>2. Students discuss what information they get from the pictures and the editorial, then determine the problem to be solved.<br>3. Students estimate the initial number of books available. | 1. Students can write information based on images and complete editorial.<br>2. Students can only write information based on the editorial without observing the information in the picture. |
| From real problems, students can add matrices | 1. Students present data on the results of calculating book availability.<br>2. Students provide strategies in calculating and presenting data | 1. Students present book availability information by registering one by one.<br>2. Students present information on book availability by creating a table.<br>3. Students present information about book availability by drawing a picture of a shelf. |

| **Learning Goal** | **Learning Activities** | **Hypothetical Learning Processes/Conjectures** |
|---|---|---|
| | | 4. Students write down the strategies used to calculate the increase in book availability with descriptive sentences and complete steps in the work process.<br>5. Students only write down the strategies used to calculate the increase in book availability by means of sentence descriptions.<br>6. Students immediately carry out the strategy without any descriptive explanation. |
| From real problems, students can present data in matrix form. | Students present final data on book availability by paying attention to the position on the subject bookshelf (locker). | 1. Students present final data with tables<br>2. Students present the final data in the form of boxes like the picture of a shelf.<br>3. Students present final data that is already directed at the matrix<br>4. Students can make conclusions based on solving problems in questions.<br>5. Students can make conclusions related to data presentation leading to matrices. |

After the Student Activity Sheet (LAS) and Hypothetical Learning Trajectory (HLT) were designed as in Table 1, LAS and HLT were validated by three experts in the field of Mathematics Education. Based on the validation results that have been carried out, LAS and HLT were revised according to the suggestions and comments of the experts. The results of the revision of LAS and HLT are in accordance with the characteristics of the PMRI approach that can be used in classroom learning.


**Figure 2.** Student Activity Sheet

*Experimental Design Stage*

At this experimental design stage there are two cycles, namely the pilot experiment as cycle 1 and the teaching experiment as cycle 2.

*Pilot Experiment (Cycle 1)*

In cycle 1, a pilot experiment stage was carried out by testing three activities on the student activity sheet that had been designed for 6 senior high school students in grade XI.In activity 1, students are asked to observe and collect information from contextual problems in the images and editorials provided, and analyze what problems will be solved. Based on observations and student work results, in general, students have been able to collect data where some write complete data based on editorials and images, and some write information obtained in the images. This is in line with Aribah's research (2024) where the presence of contextual problems makes students able to describe and express the information and concepts they get, either by listing, images, diagrams, and so on. However, there are also those who only write data from the editorials provided. In general, all students have been able to determine the problems to be solved, namely determining the availability of books and presenting the data, it can be seen that they have written what was asked from the contextual problem.

In activity 2, students are asked to present data on the availability of books that they have obtained in activity 1 and that have been added, and write down the strategies they apply. In general, they have been able to present the data in various ways such as by listing

one by one and making a table. The strategies they use to make additions include calculating manually one by one by listing or directly by adding up the table that has been presented previously. This shows that students have been able to describe and express the concepts they receive such as by drawing, making tables, diagrams, and so on (Aribah, 2024).

In activity 3, students are asked to present the final availability of books by paying attention to the position on the shelf and concluding the problem. In this activity, students are expected to be able to direct the presentation of data in the form of a matrix through data presentation that pays attention to the position and label of the subject on each shelf. The results of students' answers in this activity show that there are students who have directed towards the concept of a matrix. However, there are students who have not yet reached the concept of a matrix. This can be seen from the students' answers in Figure 3 and Figure 4.

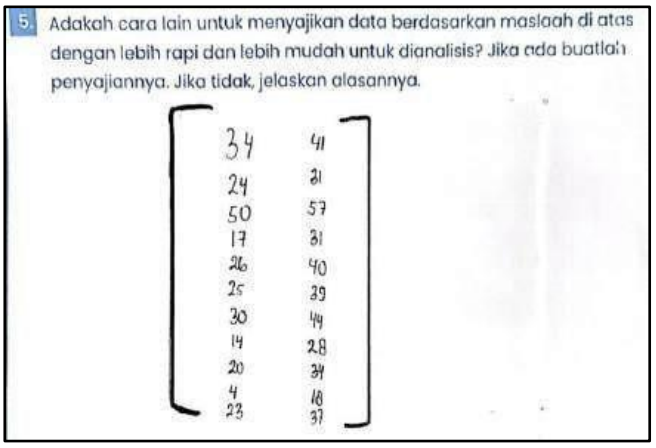


**Figure 3.** Results of Students' Answers to the Matrix Concept

Figure 3 shows that students present their data already leading to the matrix concept as seen from their answers written in brackets and there are rows and columns in them. However, students' answers are still not quite right because they do not write the final data on the availability of subject books but students present the first column as the initial availability and the second column as the final availability.In this case, the researcher conducted an interview with the student to ask about his understanding of matrices and I got the answer that the student had studied matrices a little and said that the activities carried out could lead to matrices such as the following interview dialogue.

Q: “Why did you think of presenting the data like this (Figure 3)?”

S: "Yes ma'am, from the start of activity 2 I presented the data using a table and for a neater presentation I used a matrix so that there weren't too many words."

Q: “Do you understand the concept of matrices?”

S: “A little bit, ma'am. I've read about matrices and it seems like this data can use matrices.”

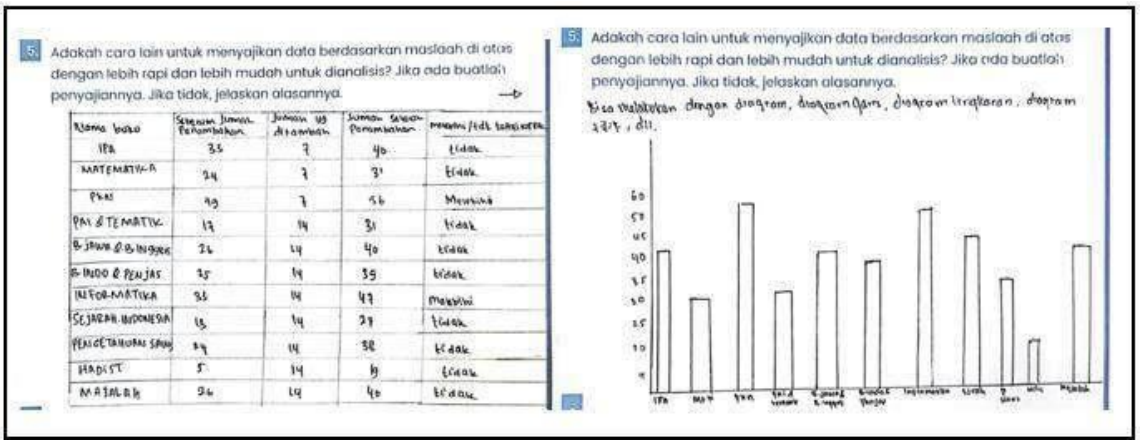


**Figure 4.** Student Answer Results Not Matrix Concept

Figure 4 shows the results of students' answers that do not yet lead to the concept of matrices. Figure 4 shows that students present the final data on book availability using tables and histograms, where they do not pay attention to the position of each book availability on the shelf according to the subject.

In general, all students have been able to conclude the results of the problems that were carried out. Some concluded based on the problems in the editorial, and some concluded related to the presentation of data that can be done and lead to matrix concept that shows the ability to articulate mathematical problems in this learning activity (Aribah, 2024).

*Retrospective Analysis Cycle 1*

The results of students' answers at the pilot experiment stage were used as input for improving the series of activities in the activity sheet to make it better. Based on the analysis of student answers and observations, the researcher found that some students were still confused about the first 3 questions, as seen from the many students who asked how to do it and the variety of student answers that did not lead to the purpose of the activity. In these questions, students still did not direct them to the concept of matrices. This is like in Zahwa (2023) study that students often have difficulty with matrix questions because of the way the

concept is applied in solving problems. Therefore, the researcher decided to improve and add information to the first question to support students in understanding the concept of matrices that they wanted to direct. The improvements made can be seen in Figure 5 below.

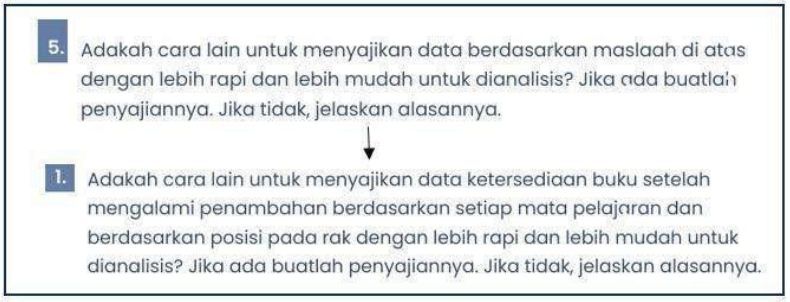


**Figure 5.** Activity Sheet Improvement

Figure 5 shows the improvements made, namely by adding information "...availability of books after additions based on each subject and based on position on the shelf..." to support understanding of the concept that is being directed, and there are improvements to the spelling errors. However, there are some students who show unexpected strategies, such as solving with histograms, and there are students who have been able to present data directly in the form of a matrix by relying on the stages of the activities provided and the knowledge they have.

*Teaching Experiment (Cycle 2)*

In cycle 2, the teaching experiment stage was conducted by testing it on 35 grade XI students. Students were divided into 8 groups, 6 groups consisting of 4 students and 2 groups consisting of 5 students.

*1. Activity 1 Stating Data Forming a Matrix*

The learning objective in activity 1 is from real problems (lockers), students can express data in matrix form. In this activity, students will be directed to observe the images and editorials provided, then can write down the information obtained. This activity can direct students to find out the availability of books on each shelf according to the subjects that will represent the elements of the matrix.. The first activity that students do is to count the number of initial books available on each shelf according to the subject and analyze what problems will be solved. In completing the first activity, all groups are able to count and write down what is known and what is asked as in Figure 6.

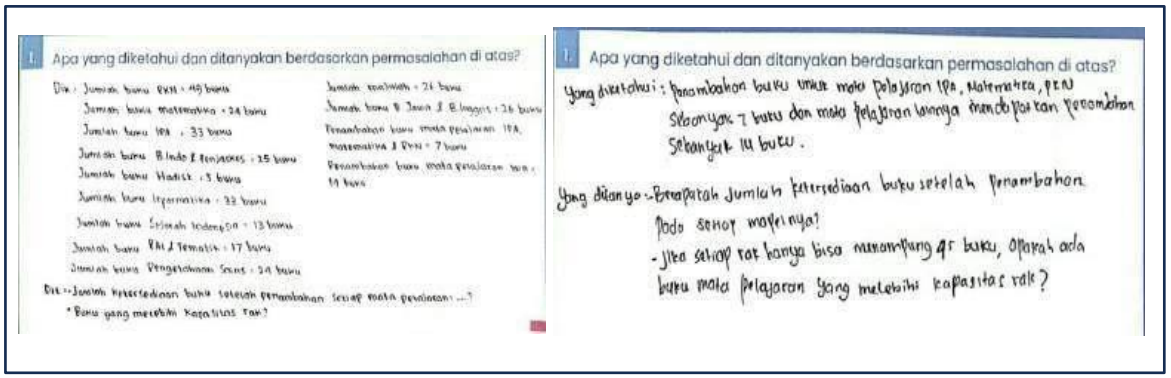


**Figure 6.** Answers to Activity 1

Figure 6 shows the results of students' answers for activity 1. Where groups 1 and 2 listed information from the editorial and book availability by calculating from the contextual picture of the bookshelf (locker) of the subject. While groups 3 to 8 wrote down information only from the editorial. In terms of finding information, the dominant way is by calculating one by one. In terms of presentation, some registered, or some wrote directly in the picture.

*2. Activity 2: Adding Matrices*

The learning objective in activity 2 is to address real problems (lockers), and students can add matrices. In this activity, students will be directed to add up the initial availability with the addition of books, then can present the data obtained with their respective strategies that show the ability to express matrix concepts in pictures, tables, lists, and so on (Aribah, 2024). This activity can direct students to know that matrix addition is done on each type of book according to the subject label. This will provide an overview of adding matrix elements must be added in accordance with the position or location of each row and column. In the first 2 questions of the activity, based on HTL, students are asked to present initial data on book availability from the results of information that has been found in activity 1. In solving the problem of activity 2, the first question, students can present the data by registering one by one, making boxes like shelves, and making tables as in Figure 7.


**Figure 7.** Answer to Activity 2 No. 1

Figure 7 shows the results of students where 6 groups present by listing, group 5 presents in a table, and groups 1 and 3 present like shelf boxes. Next, continued with the second question, students are asked to analyze and write down the strategies they use to calculate the availability of books after being added.Based on the completion of activity 2 number 1, there are 6 groups that can write their strategies such as making a table by calculating the initial number of books and adding them to produce the overall result, then groups 1 and 3 calculate the number of books using the boxes that have been described and then add additional books, and group 5 by carrying out addition operations by registering.

In activity 2 questions 3 and 4, students are asked to write downthe solution by implementing the strategies they have written before, namely some register, count in boxes, and tables. Then continued with the presentation of the results of the solution that has been done as in Figure 8.

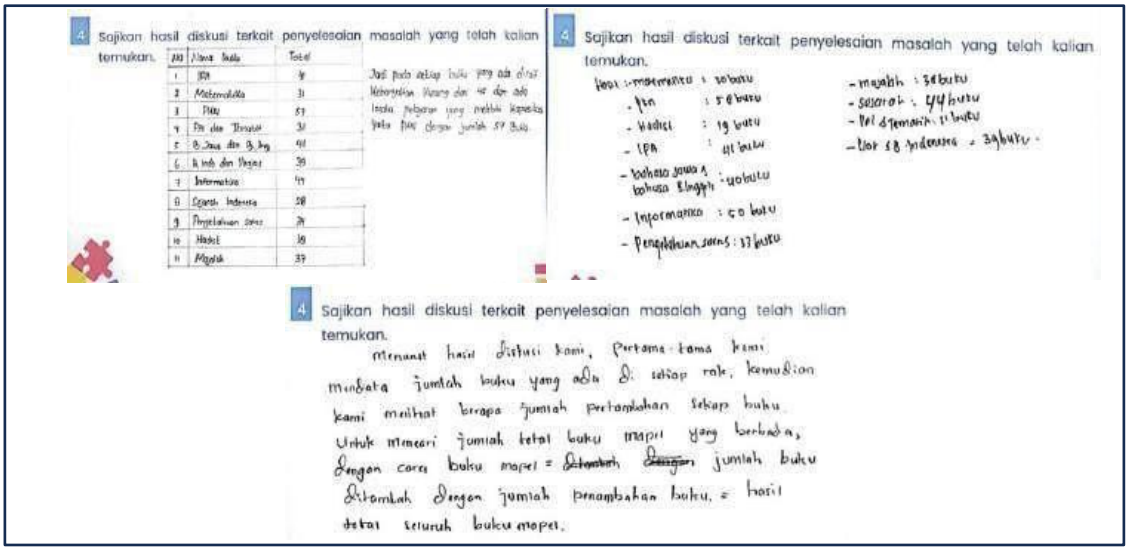


**Figure 8.** Answer to Activity 2 No.4

Figure 8 shows that students implemented new tables, listed the final results, and some presented them descriptively or explanatorily.

*3. Activity 3 Presenting Data in Matrix Form*

The learning objective in activity 3 is from real problems (lockers), students can present data in matrix form. In this activity, students will be directed to present the data from the addition results obtained by paying attention to the position of the lockers according to the subject label. This activity can direct students to present data in the form of a matrix that has rows and columns. This will give students an idea that to present in matrix form, each

element must be in accordance with the position or location of each row and column.In activity 3 based on HTL, students present data on book availability after being added by paying attention to the position on the shelf according to each subject and concluding the problem. In solving it, in general all groups have been able to present the final data by paying attention to the position of each shelf according to the subject label which leads to an understanding of the matrix concept. This is as seen in Figure 9.

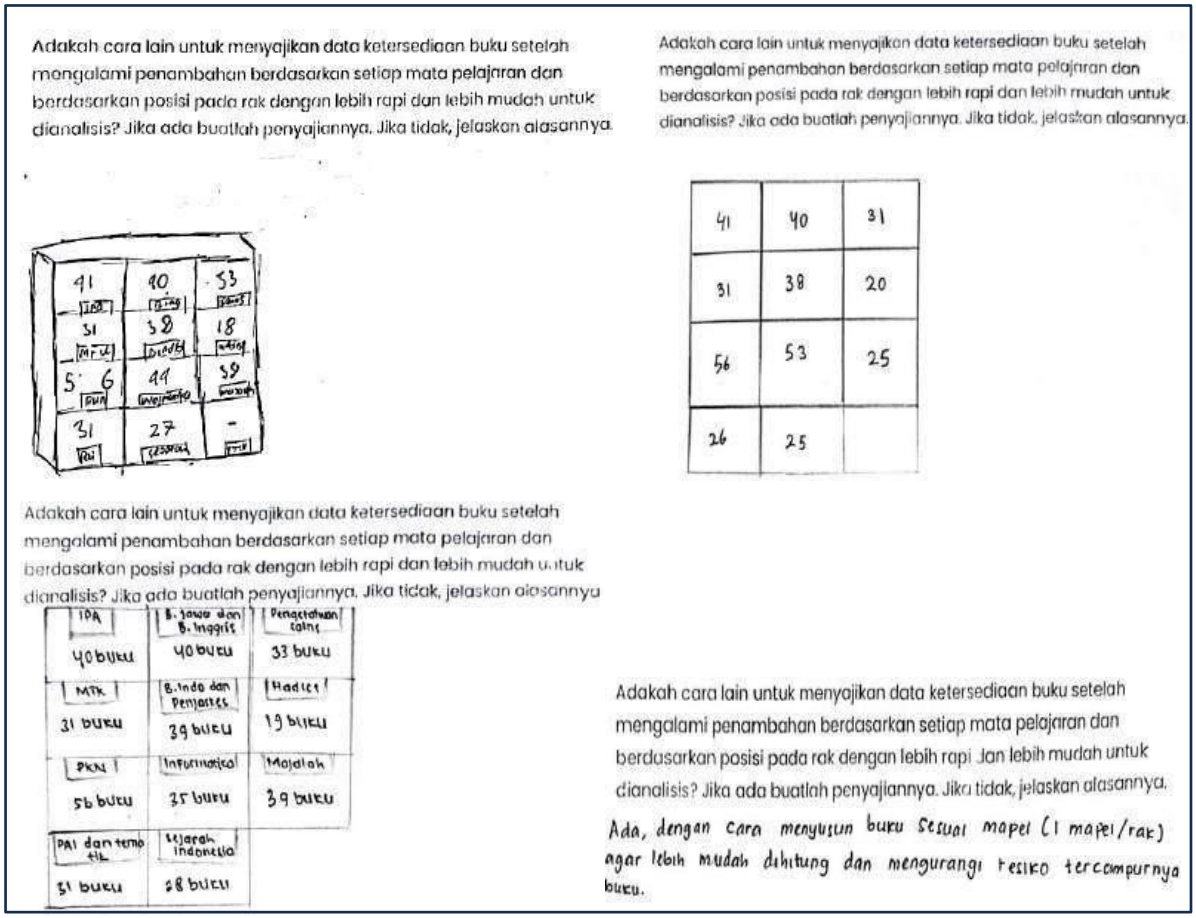


**Figure 9.** Answer to Activity 3 No.1

Figure 9 shows that all groups have been able to present the data by paying attention to the position of the shelf boxes and adjusting them to the position of each eye.lesson. In activity 3 No.1 there is one box on the shelf, namely the Physical Education subject does not have books available so that there are students who write "-" or a strip indicating that the box does not have books. However, there are also students who do not write and describe the shelf that does not have the book.

Then the students conclude the problem in activity 3, there are several groups that conclude this problem by presenting data in matrix form as in Figure 10.

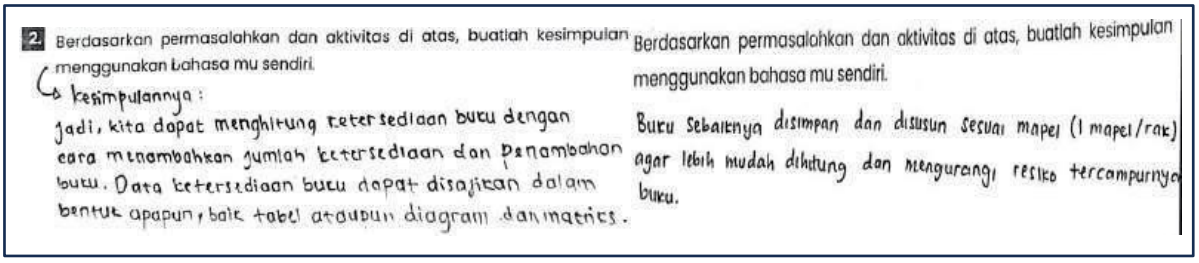


**Figure 10.** Answer to Activity 3 No. 2

After carrying out the activity, the researcher as a teacher provides reinforcement related to the explanation of the concept being studied leading to the matrix. The teacher invites discussion related to the results that have been worked on, directs the presentation of data in the form of boxes like shelves, then invites students to eliminate the subject variables. lessons and write in brackets, and explain that the activities that have been carried out lead to the presentation of data in the form of a row and column matrix. With this LAS, it helps students to be active in the discussion room prepared by the teacher in the learning process, which can help students understand the concept of the material easily both individually and in groups (Zahwa, 2023). Based on the ALT that occurred during learning, it can be seen that students are able to present data in the form of a matrix as in Figure 11.

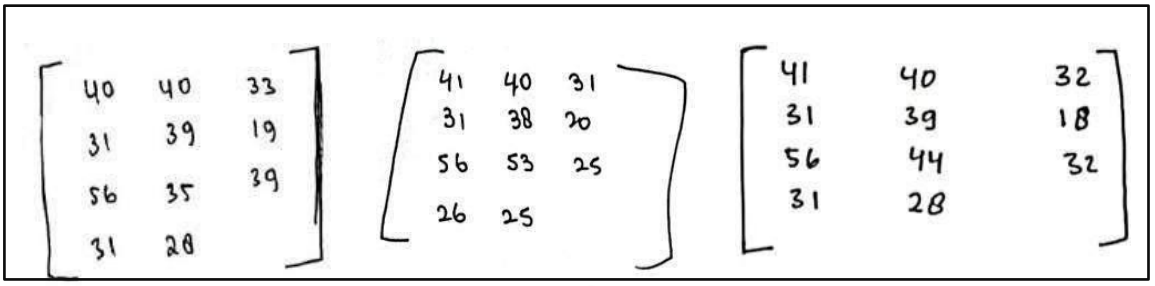


**Figure 11.** Matrix Data Presentation

Figure 11 shows the results of data presentation in the form of a matrix that has been done by students. Overall, eight groups have written the matrix.

*Retrospective Analysis Cycle 2*

The activities designed by the researcher aim to provide learning to support conceptual understanding of the matrix material. Students have worked on the activities

given based on the hypothetical learning conjecture design or initial conjectures that have

been predicted. In this learning process, there are various student answers in solving the problems or activities given.Based on the activities that have been carried out by students, students have been able to present data on bookshelves (lockers) for subjects in the form of a matrix after carrying out the activities given. This shows that students have understood the concept of matrices through the real context given and applied it to the problems given. Providing meaningful experiences through the three activities with real contexts that have been designed can increase student interest and build strong understanding (Chn, 2024; Aribah, 2024; Andita, 2024). The solutions given and carried out by students are generally in accordance with the designed HLT. This shows that learning using PMRI using the designed HLT can support students' understanding of the matrix concept through learning activities with real contexts that are often encountered in everyday life, and help students develop from the informal stage to the formal stage (Sari, 2024; Utari, 2023; Sulastri, 2023).

**Conclusion and Suggestion**

During the learning process, learning activities designed using real contexts that students often encounter, namely the context of subject bookshelves (lockers), can support students' understanding of the matrix concept. The use of contextual problems that are very close to students' lives makes students more familiar with the problems given. The use of the context of subject bookshelves (lockers) in the school environment as the problems given can facilitate directing to the matrix concept, such as the boxes formed from the partitions of the bookshelves (lockers) can represent the position of the matrix elements and indicate the presence of rows and columns. So that this context can minimize students' matrix concept errors and can support a deeper understanding of the matrix concept for students.The learning plan developed from the student activity sheet consists of three activities, namely (1) stating data to form a matrix from information in the image and the editorial of the availability of books on the bookshelf (locker), (2) adding up the matrix by calculating the availability of each subject book on the bookshelf (locker), (3) presenting data in the form of a matrix using the results of adding up the availability of books on the bookshelf (locker). The researcher suggests that further researchers who are interested in researching matrix material should use a real context that is close and can be imagined by students and use sentences that are easy to understand so that they can support students in understanding the concept of the matrix.

**References**

Andita, S., Syutaridho, & Nizar, H. (2024). Development of Blog-Based Learning Media With Sarong Context on Lines and Angles Material. In *MATHEMA JOURNAL E-ISSN* (Vol. 6, Issue 2). https://doi.org/10.33365/jm.v6i2.2852

Aribah, A. K. Z., & Swastika, A. (2024). Students Mathematical Communication Skills in Solving Contextual Problems of Three Dimensional Figures at Junior High School Level. *MATHEMA: JURNAL PENDIDIKAN MATEMATIKA*, *6*(1), 141-151. https://doi.org/10.33365/jm.v6i1.3265

Astuti, H. Y. (2023). Evaluasi Efektivitas Pembelajaran Berdiferensiasi Materi Matriks dengan Memperhatikan Kearifan Lokal Pertanian Padi sebagai Konteks Belajar. *JSG: Jurnal Sang Guru*, *2*(3).

Chn, R. R., Putri, R. I. I., Hartono, Y., Susanti, E., & Nusantara, D. S. (2024). Teaching and Learning Fraction: A Systematic Literature Review. In *MATHEMA JOURNAL E-ISSN* (Vol. 6, Issue 2). https://doi.org/10.33365/jm.v6i2.4037

Gravemeijer, K., & Cobb, P. (2006). *Design Research from A Learning Design Perspective. Dalam Jvd. Akker, K. Gravemeijer, S. Mckenney, & N. Nieveen (Penyunting), Educational Design Research* (17-51). Routledge Taylor and Francis Group 4.

Ostian, D., Zulkardi, Z., & Susanti, E. (2023). Kemampuan Koneksi Matematis Siswa pada Materi Bangun Datar dengan Konteks Wisata Palembang. *Indiktika: Jurnal Inovasi Pendidikan Matematika*, *5*(2), 211-221.https://doi.org/10.31851/indiktika.v5i2.11391

Rawani, D., Putri, R. I. I., & Susanti, E. (2023). The Reflective Teaching Practices using PMRI and Collaborative Learning. *Jurnal Pendidikan Matematika*, *17*(1), 69-88. https://doi.org/10.22342/jpm.17.1.17208.69-88

Rohiyatun, B. (2019). Standar sarana dan prasarana pendidikan. *Jurnal Visionary: Penelitian Dan Pengembangan Dibidang Administrasi Pendidikan*, *7*(1). https://doi.org/10.33394/vis.v4i1.1974

Rohmah, D. P. K., Ivania, V., & Zuliana, E. (2024). Pembelajaran Pecahan Melalui Pendekatan PMRI Berbantuan Media Bambu. *Cartesian: Jurnal Pendidikan Matematika*, *3*(02), 35-43. https://doi.org/10.33752/cartesian.v3i02.5707

Sari, F. Y., Putri, R. I. I., Susanti, E., & Nusantara, D. S. (2024). Ratio Material Learning Design Using the Context of Cooking Rice to Help Elementary Students Understand Concepts. *INOMATIKA*, *6*(1), 54-66. https://doi.org/10.35438/inomatika.v6i1.443

Sari, N., Saragih, S., Napitupulu, E., Rakiyah, S., Sari, D. N., & Sirait, S. (2024). Hypothetical Learning Trajectory Through the Problem-Based Learning in Junior High School Students. *KnE Social Sciences*, 1122-1133. https://doi.org/10.18502/kss.v9i13.16037

Siregar, M. R. B., Angelina, A. D., Maisarah, M., Annisa, L., Mardianto, M., & Haidir, H. (2022). Peran Literasi Baca Tulis Dalam Menumbuhkan Minat Membaca Siswa di Madrasah Tsanawiyah Negeri. *Munaddhomah: Jurnal Manajemen Pendidikan Islam*, *3*(2), 149-159. https://doi.org/10.31538/munaddhomah.v3i2.237

Suban, A., Nursita, L., Halimah, A., Isnaeni, N., & Rahayu, S. (2024). Book Arrangement and Reading Corner of The Library in Madrasah Ibtidaiyah Manggarupi Kabupaten Gowa. *Educational Leadership: Jurnal Manajemen Pendidikan*, *3*(2), 203-210. https://doi.org/10.24252/edu.v3i2.43789

Sulastri, W., & Wulantina, E. (2023.). Pengembangan LKPD Berbasis Pendekatan Pendidikan Matematika Realistik Indonesia (PMRI) Untuk Meningkatkan Kemampuan Representasi Matematis Siswa. In *MATHEMA JOURNAL E-ISSN* (Vol. 5, Issue 2). https://doi.org/10.33365/jm.v5i2.2842

Sulistina, L., & Negara, H. R. P. (2024). Kajian concept image siswa pada materi matriks. *Journal of Didactic Mathematics*, *5*(1), 42-56. https://doi.org/10.34007/jdm.v5i1.2196

Ulfa, C., & Wijaya, A. (2019, October). Expanding hypothetical learning trajectory in mathematics instructional. In *Journal of Physics: Conference Series* (Vol. 1320, No. 1, p. 012091). IOP Publishing.

Utari, R. S., Zulkardi, Z., Putri, R. I. I., & Susanti, E. (2023). Development of Statistical Literacy Questions for Prospective Mathematics Teachers. *INOMATIKA*, *5*(1), 1-15. https://doi.org/10.35438/inomatika.v5i1.367

Wanabuliandari, S., Rahmawati, R. A., & Bintoro, H. S. (2023). Improving Mathematical Concept Understanding Ability of Junior High School Students with Conceptual Understanding Procedures Learning Model. *IJECA (International Journal of Education and Curriculum Application)*, *6*(2), 179-186. https://doi.org/10.31764/ijeca.v6i2.16251

Widyastuti, R., Anggoro, B. S., Negara, H. S., Yuliani, M. D., & Utami, T. N. (2020, February). Understanding mathematical concept: The effect of savi learning model with probing-prompting techniques viewed from self-concept. In *Journal of Physics: Conference Series* (Vol. 1467, No. 1, p. 012060). IOP Publishing. Doi: 10.1088/1742- 6596/1467/1/012060

Wigati, T., Wardono, W., & Purwanti, E. (2020). Analysis of mathematical literacy skills through PMRI approaches of elementary school students. *Journal of Primary Education*, *9*(3), 303-310. https://doi.org/10.15294/jpe.v9i3.39212

Zahara, E., Murni, A., & Hutapea, N. M. (2020). Development of Mathematics Learning Tools by Implementing Numbered Head Together Type Cooperative Models to Improve Students' Mathematical Understanding Ability in Matrix Topic. *Journal of Educational Sciences*, *4*(2), 250-260. https://doi.org/10.31258/jes.4.2.p.250-260

Zahwa, N., Nuraeni, Z., & Araiku, J. (2023). Development of Philosophy Based-Students Worksheet on the Matrix. *Jurnal Pendidikan Matematika*, *17*(2), 149-166. https://doi.org/10.22342/jpm.17.2.19782.149-166

Zulkardi, & Putri, R. I. I. (2019). New school mathematics curricula, PISA and PMRI in Indonesia. *School mathematics curricula: Asian perspectives and glimpses of reform*, 39-49. https://doi.org/10.1007/978-981-13-6312-2_3