APPLYING RME IN THE COVID-19 PANDEMIC: AN EFFORT TO IMPROVE SIXTH GRADERS’ MATHEMATICAL CONNECTION ABILITY

Sri Rejeki¹, Addien Arso Aji²*

¹,²* Universitas Muhammadiyah Surakarta, Surakarta, Indonesia

*Corresponding author. Universitas Muhammadiyah Surakarta, Surakarta, Indonesia

E-mail: sri.rejeki@ums.ac.id¹
        a410180001@student.ums.ac.id²

Received 18 August 2022; Received in revised form 26 November 2022; Accepted 31 December 2022

Abstract

Mathematical connection ability is an essential skill for students. There are still limited studies focus on developing the skills through applying specific learning approaches. Therefore, this study aims to improve students’ mathematical connection ability through the Realistic Mathematics Education (RME) approach with a limited face-to-face learning setting in the CoViD pandemic era. This study used the sequential explanatory mixed-methods. The sample and the population in this study were 15 sixth-grade students at one of the state elementary schools in Sragen, Central Java, Indonesia. The data collection techniques used in this study were tests, documentation, and interviews. In the quantitative part, the data analysis technique used is a sign test. In contrast, the qualitative aspect of the data analysis technique involves three stages: data reduction, data presentation, and conclusion drawing. This study used triangulation with interviews and documentation. Based on the sign test, there was a significant improvement in students’ mathematical connection ability. Furthermore, based on qualitative data analysis: (1) In the pretest, students with high mathematical connection ability, only one indicator was met. In contrast, in the posttest, three indicators were met, (2) in both pretest, and posttest, students with medium and low mathematical connection ability can only be met one indicator. These findings show that the achievement of indicators increases only in students with high mathematical connection ability.

Keywords: CoViD-19 pandemic, mathematical connection ability; realistic mathematics education.

This is an open access article under the Creative Commons Attribution 4.0 International License
INTRODUCTION

Mathematics is a science to train individual reasoning used to solve everyday problems, such as developing the ability to count and interpret data. According to Konita et al., (2019), the purpose of learning mathematics is so that students have reasoning skills in design and nature, perform manipulations in general and explain mathematical opinions and statements. Students must have five basic mathematical skills: problem-solving, reasoning and evidence, communication, connection, and representation (NCTM, 2000).

The ability of mathematical connection is an important for the student. According to Millaty (2021), connection skills must be developed in mathematics learning. This is because students must be able to connect concepts in mathematics and with fields outside of mathematics (Dewi & Masrukan, 2018; Sari, 2016). The purpose of developing mathematical connection abilities, according to NCTM (2000), is to deepen knowledge insights and view mathematics as a unit of other sciences. Meanwhile, according to Ningrum et al., (2019), mathematical connections emphasize that mathematics is taught as a subject that is interrelated and interconnected between steps and concepts solve problems in everyday life. Indicators of mathematical connection ability, namely the relationship between mathematical ideas, connections with studying other sciences outside of mathematics, and the relationship of mathematics with everyday life (NCTM, 2000).

The previous indicates the importance of the ability of mathematical connections in students. However, the mathematical connection ability of students in Indonesia showed unsatisfactory results. This fact can be seen from the effects of research conducted by Permatasari & Nuraeni (2021), which shows that the average students’ mathematical connection ability score in Indonesia is still low. Furthermore, the mathematical connection ability of students in Indonesia is still low, which is reflected in the number of students who have difficulty associating mathematics with daily life (Nugraha, 2018; Pramujiyanti Khotimah & Masduki, 2019; Setiawarni et al., 2019).

Realistic Mathematics Education (RME) can be an alternative learning approach to learning mathematics which was originally mechanistic to be realistic. Realistic problems can be a source of mathematical concepts or knowledge emergence (Febriyanti et al., 2019). According to Adjie et al (2020), mathematics learning pays less attention to examples in the real world while material in mathematics learning often appears in everyday life, while RME is an approach that connects with everyday problems. Therefore, this study raises problems related to the influence of the RME approach on students' mathematical connection ability.

According to van den Heuvel Panhuizen (2020), there are six principles in RME, namely (1) the activity principle, students are active in learning; (2) the reality principle, the ability of students to connect mathematics to problems in the real world. (3) the level principle, which means that students’ level of understanding varies greatly (4) the intertwine ment principle, which means that mathematics is interrelated, (5) the interactivity principle, which means that mathematics learning is not just an
individual activity, but a social activity and (6) the guidance principle, the teacher plays an active role in the learning process. Steps in RME learning can be done by understanding, explaining, solving contextual problems, comparing, discussing students’ answers, and concluding (Hobri, 2009). Thus, RME learning is expected to help to improve mathematical connection capabilities.

Based on previous research, the application of RME has an impact on improving the learning outcomes of grade fifth students on the material of space building volume (Kurino, 2017). Furthermore, RME also have positive impact on students’ learning activities and completion (Abujina et al., 2013), problem solving skills (Nursyahidah et al., 2018), and critical and creative thinking skills (Dhayanti et al., 2018). The research conducted by Rini et al., (2017) shows that mathematics learning using the RME approach can improve the mathematical connection ability of grade third students on integer material. These findings are also in line with research conducted by Ba’ih et al., (2020), which shows that there is an influence of the Indonesian Realistic Mathematical Approach or Pendidikan Matematika Realistik Indonesia (PMRI) on the mathematical connection ability of grade ninth students on number material. These studies show a positive impact on the application of RME on the cognitive aspects of students, one of which is the ability of mathematical connections. However, there has been no research that focuses on circle topic for grade VI elementary schools (SD), especially during the CoViD-19 pandemic.

Based on the letter issued by the Ministry of Education and Culture, Research and Technology Number 2 and 3 of 2020 related to the prevention and countermeasures of CoViD, all educational institutions must apply online learning or PTMT (Pembelajaran Tatap Muka Terbatas or Limited Face-to-Face Learning). This study uses a setting PTMT. RME is one of the practical approaches to improve the ability of mathematical connections in students in standard learning settings. With the PTMT setting, especially in the broad circle material, it is hoped that RME will also be effective in improving the mathematical connection ability of grade sixth students.

The RME approach is one of the learning approaches that have a positive impact on being used in learning during the CoViD-19 pandemic. According to Riajanto (2021), the RME approach can help students achieve mastery of mathematical connections with distanced learning. Applying the RME approach to learning during the CoViD-19 pandemic can also improve students’ understanding of concepts and mathematics learning outcomes (Ifati et al., 2021; Sitompul, 2021) and students’ mathematics communication ability (Wahyuni & Rejeki, 2022). According to Afriansyah et al. (2021), the thinking ability obtained in learning with the RME approach is better than in conventional learning. It can be seen that the approach needs to be implemented during the CoViD-19 pandemic to help the learning process, even though it still has to be done with limited learning.

Based on the explanation described above, it is necessary to research increasing mathematical connections with the RME approach. RME is one of the approaches that can improve the ability of mathematical connections in elementary school students in the PTMT setting,
specifically on the area of the circle. Therefore, this study aims to describe the effectiveness of mathematics learning with the RME approach to students’ mathematical connection ability.

**METODE PENELITIAN**

This study used a sequential explanatory mixed-methods design. According to (Creswell, 2014), it is a design in which the researcher begins by collecting and analyzing the data quantitatively, proceeds to examine his findings more in-depth qualitatively.

The sample, as well as the population in this study, was 15 grade sixth students at a state elementary school in Kalijambe District, Sragen Regency, Central Java Province, Indonesia. The object of this study is the ability of mathematical connections of grade sixth students to the topic of circle. Qualitative data analysis in this study consisted of 6 students (2 students of high mathematical connection ability, 2 medium mathematical connection ability and 2 low mathematical connection ability).

Quantitative data collection techniques in the study were carried out with tests, which included pretest and posttest. The data collection techniques used in this study were tests, documentation, and interviews. Then mathematics education lecturers and elementary school teachers validated the test instrument.

Meanwhile, qualitative data is obtained from the documentation of student work results and interviews to strengthen the test data obtained. The validity of qualitative information is ensured using tri-angulation techniques. The stages of the study carried out by the researcher, are described in Figure 1.

In the quantitative section, data analysis was carried out with a small sample sign test. Sign test is one of the steps of a non-parametric test. The sign test was carried out to determine the extent of the effectiveness of the RME method used to improve students’ mathematical connection ability in mathematics learning. Analysis of if quality data is carried out through three stages, namely data reduction, data presentation, and drawing conclusions.
RESULTS AND DISCUSSION

The material in this study is related to the topic of the area of circles, which is six graders’ material. The ability that students must expert is to explain the estimated area of the circle to be used for problem-solving in everyday life. This study used three test questions, where the questions were used for Pre-test and Posttest. However, this article will focus on discussing one of the following questions:

An artist cuts a cassette disc to make it into a work of art. The artist has created a pattern of cuts on the cassette disc, as shown above. What elements of the circle are formed from the design?

![Figure 2. Questions Test](image)

Applying learning with the RME approach is carried out in PTMT to class VI students. As for the steps in RME understanding, namely (1) applying contextual problems to students, (2) solving these contextual problems independently, (3) pursuing interactions between students and teachers, (4) comparing answers and discussing answers together, (5) carrying out the results of answer discussions with students. The material used for this study is related to the area of the circle where the material has sub-material, namely related to understanding and elements in the circle, looking for the scope of the circle, and also looking for the area of the shaded circle. In this case, students look for the elements of the circle in the cassette image, such as diameter, radius, center point, and others. Application with the RME approach can also be made using objects around the student in the form of a circle. Circular objects are presented in the Table 1.

<table>
<thead>
<tr>
<th>No.</th>
<th>Circular objects</th>
<th>Item Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Coin</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Wall Clock</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Plate</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Shirt Buttons</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Close the Jar</td>
<td></td>
</tr>
</tbody>
</table>

A sign test was carried out to see whether the RME method influenced the level of mathematical connection ability of grade VI students on the broad material of the circle. The hypothesis used is $H_0$, which states that the RME method does not significantly affect students’ mathematical connection ability. At the same time, $H_1$ reads that the RME method substantially affects students’ mathematical connection ability. This mark test was performed using SPSS 23 software with the test criteria being $H_0$ rejected if $\text{Sig. (p-value)} < 0.05$, while for other conditions, $H_0$ is accepted.
Based on the results above, it can be seen that in the *Exact Sig* line, the probability value is 0.000. Then $H_0$ is rejected because the probability value is $0.000 < 0.05$. Thus, the decision taken was $H_1$ which stated that the RME method had a significant effect on the students’ mathematical connection ability. After analyzing the data, students were further categorized into three categories: students with high, medium, and low mathematical connection capabilities, each type consisting of two students.

**a. The improvement of Mathematical Connection Ability in High Math Proficiency Students**

From the group of students who are capable of high mathematical connections, an analysis of the work results of the two students was carried out, namely Student 1 (S1) and Student 2 (S2). The results of the study can be seen in figures 3 and 4.

![Figure 3. Student work 1 (S1) pretest](image1)

![Figure 4. Student work 1 (S1) posttest](image2)

Based on Figure 2, S1 can only meet the indicators of writing down the mathematical concepts underlying answers. Meanwhile, in Figure 3, S1 can meet all existing indicators, namely understanding the problems of daily life in a mathematical model, such as a tape, three-point on the edge of the circle, there is an AB line with an O point in the middle, and also S1 can write down the relationship between objects from mathematical concepts such as the distance of the center of the circle with the edge circles, lines connecting two points, as well as S1 can also write down the mathematical concepts underlying the answer entirely and precisely. After doing Posttest, students can meet all indicators of mathematical connections, such as understanding problems in everyday life in mathematical models, writing down relationships between objects of mathematical concepts, and writing down mathematical concepts that underlie answers. The results of the interview with S1 are presented as follows.

Based on the interview results, it can be seen that S1 meets all mathematical connection indicators, namely understanding the problems of daily life in the form of mathematical models, writing down the relationships between mathematical objects and concepts, and the mathematical ideas underlying the answers.

Next are presented Figures 5 and 6 of the results of S2 work at the time of Pre-test and Posttest.

![Figure 5. Student work 2 (S2) pretest](image3)
Figure 6. Student work 2 (S2) posttest

Based on Figure 5, S2 can only meet two indicators: understanding problems in everyday life in mathematical models and writing down mathematical concepts that underlie answers. Meanwhile, in Figure 6, S2 can meet all existing indicators, namely understanding the problems of daily life in mathematical models, such as circle-shaped tapes, AB lines, and the O point in the middle. There are three points, namely A, B, and C. Meanwhile, S2 can also meet the indicators of writing down the relationship between objects and mathematical concepts, such as lines connecting two circle points. Also, S2 meets the last indicator, namely, writing down the mathematical ideas underlying the answers. The results of the interview with S2 are presented as follows.

Based on the interview results, it can be seen that S2 meets all mathematical connection indicators, namely understanding the problems of daily life in the form of mathematical models, writing down the relationships between mathematical objects and concepts, and writing down the mathematical ideas underlying the answers. In students who have a high mathematical ability.

b. The improvement of Mathematical Connection Ability on Moderate Math Proficiency Students

From the group of students capable of medium mathematical connections, an analysis of the work results of the two students was carried out, namely Student 3 (S3) and Student 4 (S4). The result of the study can be seen in figures 7 and 8.

Figure 7. Student work 3 (S3) pretest

Figure 8. Student work 3 (S3) posttest

Based on Figure 7, S3 only meets the indicators of writing down the mathematical concepts underlying answers. Meanwhile, in Figure 8, S3 can only meet the indicators of writing the response’s mathematical ideas, but the solution mentioned in Figure 8 is complete and precise. After the Posttest, it turns out that S3 can only fulfill one indicator, namely writing down the mathematical concepts that underlie the solutions. The results of the interview with S3 are presented as follows.

Based on the interview results, it can be seen that S3 only meets the indicators of writing mathematical concepts. Next are presented Figures 9 and 10 of the effects of S4 work at the time of Pre-test and Posttest.
Based on Figure 9, S4 only meets the indicators of writing down the mathematical concepts underlying an answer. Meanwhile, in Figure 10, S4 can only meet the indicators of writing the response’s mathematical ideas, but the solution mentioned in Figure 10 is complete and precise. After doing Posttest, it turns out that S4 can only meet one indicator, namely writing down the mathematical concepts that underlie the answers. The results of the interview with S4 are presented as follows.

Based on the results of the interview, it can be seen that S4 only meets the indicators of writing mathematical concepts.

c. The improvement of Mathematical Connection Ability on Moderate Low Proficiency Students

From the group of students capable of low mathematical connections, an analysis of the work results of the two students was carried out, namely Student 5 (S5) and Student 6 (S6). The result of the study can be seen in Figures 11 and 12.

Based on Figure 11, S5 only meets the indicators of writing down the mathematical concepts underlying the answer, but the answer is still not long-reaching. Meanwhile, in Figure 12, S5 can only meet the indicators of writing the response’s mathematical ideas, but the solution mentioned in Figure 12 is a complete and correct answer. After doing Posttest, it turns out that S5 can only meet one indicator, namely writing down the mathematical concepts that underlie the solutions. The results of the interview with S5 are presented as follows.

Based on the interview results, it can be seen that S5 only meets the indicators of writing mathematical concepts.
Based on Figure 13, S6 can only meet the indicators of writing down the mathematical concepts underlying the answer, but the answer is not yet long-reached. Meanwhile, in Figure 14, S6 can only meet the indicators of writing the mathematical concepts underlying the answer, but the solution mentioned in Figure 14 is a complete and precise answer. The results of the interview with S6 are presented as follows.

From the excerpts of the interview, it can be seen that S6 can only meet the indicators of writing down the mathematical concepts underlying the answers. Based on the results of quantitative analysis, the RME approach can improve students’ mathematical connection ability. This finding is in line with research conducted by Bunga et al., (2016), which showed that the RME approach is better than conventional learning in improving students’ mathematical connection ability. Furthermore, a study conducted by Latipah & Afriansyah (2018) stated that mathematics learning using the RME and CTL (contextual teaching learning) approaches could improve students’ mathematical connection ability.

Furthermore, the results of the qualitative analysis showed that students with high mathematical connection abilities experienced an increase in the achievement of indicators. S1 at the time of Pretest can only meet one mathematical connection ability indicator: to write down the mathematical concepts underlying the answer. Meanwhile, in the Posttest, S1 can meet three indicators of mathematical connection: understanding problems in everyday life in a mathematical model, writing down the mathematical ideas underlying the answers, while S2, at the time of Pretest can meet two mathematical connection indicators, namely understanding problems in everyday life in the form of mathematical models and writing down mathematical concepts that underlie the answer. Meanwhile, when Posttest S2 can meet three indicators of mathematical connections: understanding problems in everyday life in a mathematical model, writing down the relationship between objects from mathematical concepts, and the mathematical ideas underlying the answers, while S2 at the time of Pretest can meet three indicators of mathematical connection, namely understanding problems in everyday life in a mathematical model, writing down the relationship between objects from mathematical concepts and writing down the mathematical ideas underlying the answers.

In students with medium and low mathematical connection ability, S3, S4, S5, and S6 did not experience an increase in the achievement of indicators. This can be seen in the students’ work when Pretest and Posttest only meet one indicator, namely writing down the mathematical concepts that underlie the answers. Research conducted by Zuyyina et al., (2018) found that the ability of mathematical connections is relatively low due to students having difficulty understanding the problem, being unable to determine the formula to be
used in solving the problem, and incorrectly choosing the step in the calculation operation. The lower the level of mathematical ability of students, the lower the level that can meet the indicators of mathematical connection ability (Julaeha et al., 2020).

Meanwhile, success in the application of learning with the RME approach has been carried out by several researchers, such as research conducted by Owuna & Tamagola (2021), that learning mathematics with the RME approach model on circle material can improve the ability of mathematical connections in students. Agustina et al., (2021) also explained that learning with a learning model with an RME approach on circle material affects student learning outcomes. Furthermore, Firdaus et al., (2022) demonstrated that the the RME significantly improves the ability of mathematical connections in students. Integrating GeoGebra could also be an innovation to enhance the impact (Ishartono et al., 2022)

Therefore, the RME approach can be one of the learning methods to improve student learning outcomes and mathematical connection ability, especially in circle material. Furthermore, integrating ICT-based media can be an innovative way in implementing RME for supporting students’ mathematics connection ability.

CONCLUSION AND RECOMMENDATION

Based on these results and discussions, it can be concluded that the application of the RME approach has a significant effect on improving students’ mathematical connection ability. This finding shows that learning on the broad material of the circle using the RME approach effectively improves students’ mathematical connection ability. Based on the analysis of each of the high, medium, and low mathematical connection abilities, it was concluded that: (1) Students with high mathematical connections significantly increase mathematical connections. This can be seen from the indicators achieved by these students. Students who have mathematical connections with high categories fall into three mathematical connection indicators in posttest results. These include understanding problems in everyday life in mathematical models, writing down relationships between objects of mathematical concepts, and writing down mathematical concepts that underlie answers. (2) Students with medium and low mathematical connections did not increase the achievement of mathematical connection indicators because students only met one indicator, namely writing down mathematical concepts that underlie the answers to pretest and posttest work. This shows the need for strategies so that the use of RME in learning can be one of the learning innovations to improve students' mathematical connection ability.

Furthermore, based on the results of the study, it can be obtained that mathematics teachers can use the RME approach as an alternative in mathematics learning to improve students' mathematical connection ability, especially on the broad material of the circle.

REFERENCES


https://doi.org/10.24127/ajpm.v12i1.5967


