25 (4), 2024, 1824-1838
Jurnal Pendidikan MIPA
e-ISSN: 2685-5488 | p-ISSN: 1411-2531
http://jurnal.fkip.unila.ac.id/index.php/jpmipa/

Correlation of Students' Engagement and Mathematical Representation Ability through Realistic Mathematics Education-Based Differentiated Learning

Gebrina Rezki Maulida[1], Rahmah Johar[1,2*], & Cut Khairunnisak[1]
[1]Department of Mathematics Education, Universitas Syiah Kuala, Indonesia
[2]The Research Center of Realistic Mathematics education, Universitas Syiah Kuala, Indonesia

Abstract: Students' mathematical representation skills are still low. One of the reasons is that students are less engaged in learning which does not facilitate students' readiness and different learning styles. Therefore, teachers must facilitate students' diversity with learning that relates to students' daily lives. This study aims to determine the correlation between students' engagement and mathematical representation ability through realistic mathematics education-based differentiated learning. The population in this study were all seventh-grade students of School A and School B. A purposive sampling method was employed to choose one class from each School, consisting of 33 students of one class from School A and 31 students of one class from School B. The research method used is quantitative research with the instrument of engagement questionnaire and mathematical representation ability test. Based on the results of the correlation test, it is found that there is a positive correlation between students' engagement and mathematical representation skills at School A and School B, meaning that the higher the student engagement, the better the students' mathematical representation skills.

Keywords: differentiated learning, student engagement, student mathematical representation ability, realistic mathematics education.

▪ INTRODUCTION

It is important to teach students mathematics so that they have basic math skills. Mathematics learning has five standards of mathematical abilities that must be owned and mastered by students, one of which is mathematical representation ability (NCTM, 2000; Zulfah & Rianti, 2018). Representation is a method to clarify what and how one is saying it (NCTM, 2000; Widakdo, 2017). Mathematical representation ability is one of the key talents that students must acquire when learning mathematics since it may promote concept understanding by assisting students to grasp the notion of mathematics by visualizing, organizing, and connecting mathematical ideas and encouraging reasoning and problem-solving through problem analysis and pattern identification (Brenner et al., 1997; Kusumawardani, 2019). This ability is crucial for students and closely relates to communication and problem-solving skills. Students need various types of representations, whether in the form of images, graphs, diagrams, or other forms of representation, to communicate something (Lette & Manoy, 2019).

Mathematics learning taught by teachers in School s can still not develop students' mathematical representation skills. It can be seen from the result of comparing and measuring students' mathematical abilities among countries by Trends in International Mathematics and Science Study (TIMSS), where Indonesia is ranked 44th out of 49 countries that participated in the test. The questions tested by TIMSS include cognitive knowledge and mathematical representation skills (Nizam, 2016). Referring to PISA 2022 data, Indonesia only improved 5-6 from the 2018 PISA results, indicating that Indonesian education is still below average, and one of the PISA assessment indicators is

Rahmah Johar
*Email: rahmah.johar@usk.ac.id

DOI: http://dx.doi.org/10.23960/jpmipa/v25i4.pp1824-1838
Received: 11 January 2025
Accepted: 19 January 2025
Published: 23 January 2025

problem-solving ability, which requires mathematical representation skills in finding solutions (Dahlan et al., 2024). From these results, it can be seen that the mathematical representation skills of students in Indonesia are still low (Mulyaningsih et al., 2020).

Research by Mulyadi and Fiangga (2022) shows that students generally have low representation skills because students have difficulty creating and using symbolic representations and images. The students' mathematical representation ability is not optimally developed because of the limited knowledge of teachers and the habit of students who learn conventionally. Therefore, students and teachers must play an active role in learning. In reality, teachers who are less creative in making learning innovations, both in selecting learning strategies and methods, make students passive, bored, less creative, and uninterested in learning mathematics (Chotimah, 2018). Teachers should build the situation so that there is student involvement in learning through social interaction (Schunk, 2012).

Student engagement in learning includes the level of attention, interest, optimism, curiosity, and enthusiasm shown by students during the learning process (Yuhaniz et al., 2018). Student engagement refers to the participation of students in the learning process, both in academic and non-academic activities, which is reflected through the behaviour, emotions, and cognitive aspects they show in the School and classroom environment (Fredricks et al., 2004). Student engagement in the learning process is an important aspect that determines the effectiveness and success of the educational process. This engagement includes students' active participation in cognitive, emotional, behavioural, and social learning activities. The success of mathematics learning is highly dependent on student participation or engagement in the learning process (Watson, 2007).

Sucipto and Firmansyah's research (2021) concluded that the lack of student engagement in learning mathematics was caused by some students hesitating to express their opinion, lazy to record what has been learned, and unenthusiastic in solving math problems that are not routine. As for the causes of students' lack of involvement in learning mathematics, teachers have not entirely created a learning environment that encourages active student engagement, students' lack of interest in understanding the material, and they tend to ask often permission to leave and tell stories with their friends during learning (Nelfita, 2023). Therefore, teachers need to pay attention to students' readiness, initial abilities, and interests, known as differentiated learning.

Differentiated learning is based on the principle that every child has the potential to learn according to their character; teachers need to consider the diversity of students and adapt learning to their level of readiness, interests, and learning preferences while encouraging collaboration between students from various backgrounds to build a deeper understanding of learning materials (Tomlinson, 2001). In addition, for mathematics learning to match students' readiness, mathematics learning should begin with real problems related to everyday life or imagined by students. This approach is known as Realistic Mathematics Education (RME). Gravemeijer (1994) says that RME is a mathematics learning approach that focuses on using real-world contexts as a starting point in the teaching and learning process.

Research by Arantini et al. (2024) illustrated that the application of differentiated learning can increase student engagement in the learning process. Research by Graciella and Suwangsih (2016) concluded that students' mathematical representation skills increased after applying mathematics learning with a realistic mathematics approach.

Some previous studies have also discussed student engagement in RME learning, such as Ramadhani et al. (2021) and Dahlan (2019); however, the number of studies that examine the correlation between student engagement and students' mathematical representation skills is still limited. Therefore, the research problem in this study is "How is the correlation between student engagement and students' mathematical representation ability through realistic mathematics education-based differentiated learning?"

▪ METHOD

Participants

The population in this study were all seventh-grade students of two public junior high School at Banda Aceh, called School A and School B who studied fraction through realistic mathematics education-based differentiated learning. They are partner School s of research centre of Realistic Mathematics Education (*Pusat Riset dan Pengembangan Pendidikan matematika Realistik Indonesia/PRP-PMRI*) Universitas Syiah Kuala (USK) team. The sample of this research was one class from School A and one class from School B, chosen because of their mathematics teachers have attended training about RME-based differentiated learning assisted by e-modules held by PRP-PMRI USK and the different characteristics of students’ gender. Each class in School A is a mixed class between male and female students, while in School B, male and female students are separated into classes. Chee et al. (2005) stated that female students have higher academic ethics and academic motivation, and are more easily engaged in academic goals and activities than male students. Therefore, the sample of this research is 33 mixed-gender students of a class from School A and 31 female students of a class from School B.

Research Design and Procedures

The research used a quantitative approach. The type of research used was correlational, aimed to determine the correlation between students’ engagement as variable (X) as and students' mathematical representation ability as variable (Y).

Data was collected in the odd semester of the 2024/2025 academic year. The treatment given is RME-based differentiated learning with the help of an e-module developed by the PRP-PMRI USK Team. The e-module that can be accessed through the GetMath platform (https://getmath.id/) consists of an initial ability test, lesson plan, learning trajectory, video triggering questions, live worksheet and evaluation test through Quizizz. The learning process was carried out in five meetings with a total of 12×40 minutes. In the first meeting, students learned the advanced concept of fractions, consisting of five learning activities, as presented in Figure 1. In Activity 1, students should choose representations of fractions in various ways to develop their creativity. In Activity 2, students should critically determine the value of fractions presented visually. In Activity 3, students should compare whether fractions 5/6 or 7/8 are closer to 1 without doing division. The students were expected to solve problems using number lines, pictures, or props such as folding paper. In Activity 4, students were expected to create stories, pictures, decorations, or poems containing mixed fractions to serve students' verbal representations. So, these activities facilitate students with audio, visual and kinesthetic learning styles.

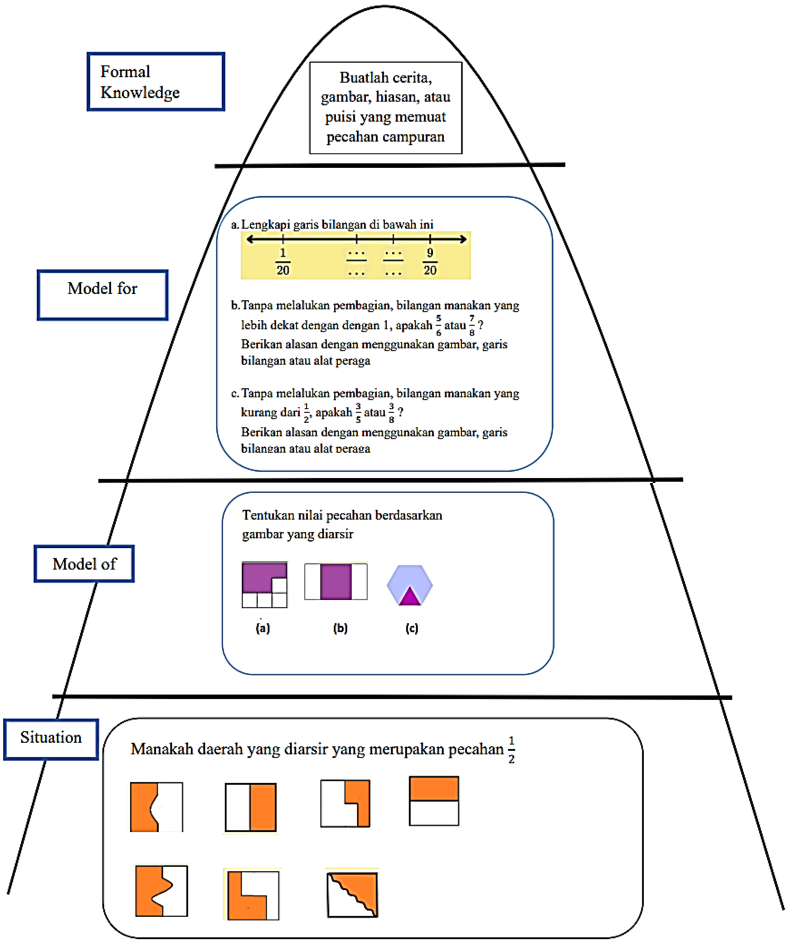


Figure 1. Learning trajectory for deepening the concept of fractions

In the second meeting, students participated in five learning exercises focused on fraction comparison. In the third meeting, students learned fraction addition and subtraction through three learning activities. In the fourth meeting, students participated in five learning exercises focused on fraction multiplication. In the fifth meeting, students practiced seven learning exercises about fraction division.

Instruments

The instrument used was a student engagement questionnaire developed Wang et al. (2016). The questionnaire consisted of 19 positive and 16 negative statements, grouped into four aspects: cognitive engagement, behavioural engagement, emotional engagement, and social engagement. The example of statements representing each aspect is presented in Table 1. The student engagement questionnaire uses a Likert scale of 1-5 to accommodate student responses. A scale of 1 to 5 indicates the level of agreement, ranging from strongly disagree (SD), disagree (D), neutral (N), agree (A), to strongly agree (SA). The validity test results of the questionnaire show a significance value of 0.000, indicating that all questionnaire items are valid. The reliability test using Cronbach's Alpha yielded a value of 0.909, indicating a high reliability level. With good validity and reliability, this questionnaire can be used as an accurate and consistent instrument to measure student engagement.

Table 1. Example of students' engagement questionnaire statements

Aspects of Student Engagement	Example of Statements
Cognitive Engagement	- I try to understand my mistakes when I get something wrong. - I do not think that hard when I am doing work for class
Behavioural Engagement	- I keep trying even if something is hard. - Not participating in class
Emotional Engagement	- I feel good when I am in math class. - I often feel frustrated in math class.
Social Engagement	- I try to work with others who can help me in math. - I do not care about other people's ideas.

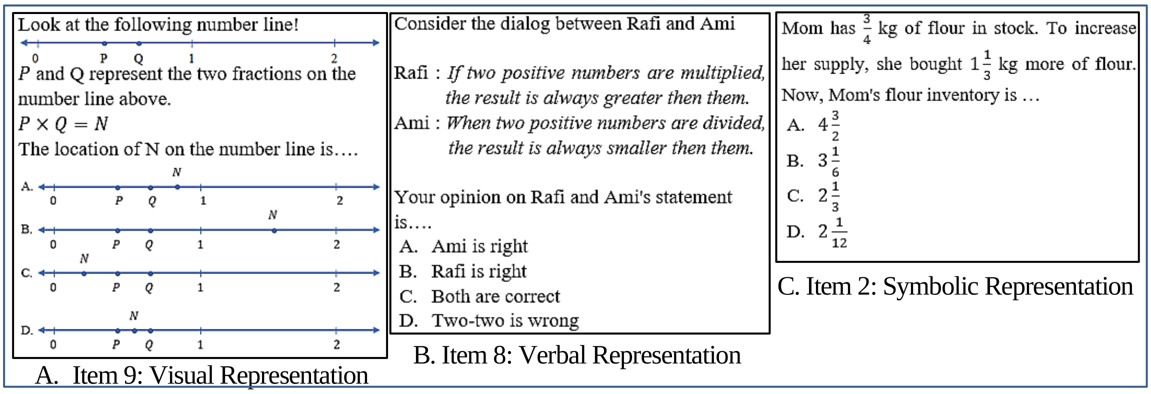
The students' mathematical representation ability test consisting of 10 multiple choice questions developed by the PRP-PMRI USK team. The mathematical representation ability test was validated by an expert in mathematics content and an expert in mathematics teaching and learning strategies from Universitas Syiah Kuala and a junior high School mathematics teacher during the Focus Group Discussion (FGD) on the application of RME-based differentiated learning at Universitas Syiah Kuala. The result shows that the test item met the criteria of being highly valid with an average validity score of 4.8, and the reliability test using Cronbach's alpha obtained a result of 0.751, which shows good reliability. Therefore, this instrument is valid and reliable for evaluating mathematical representation ability. The indicators of mathematical representation ability are presented in Table 2. The sample of the mathematical representation problems are presented in Figure 2.

Table 2. Indicators of students' mathematical representation ability

Representation	Indicator	Item
Visual Representation	• Using visual representations to solve problems • Create drawings to clarify the problem and facilitate its resolution	3. 9
Symbol Representation	• Create equations or mathematical models from other given representations • Solve problems involving mathematical expressions	1. 2. 4. 5. 6. 10
Verbal Representation	• Answer questions using words or written text	7. 8

Data Analysis

Data on students' engagement and mathematical representation ability were analyzed using the Pearson correlation test. Before that, a normality test was conducted as a requirement to confirm data were normally distributed. Furthermore, the Pearson correlation test is a data analysis technique used to find the relationship between two


Look at the following number line!

P and Q represent the two fractions on the number line above.

$P \times Q = N$

The location of N on the number line is….

A. Item 9: Visual Representation

Consider the dialog between Rafi and Ami

Rafi : *If two positive numbers are multiplied, the result is always greater then them.*

Ami : *When two positive numbers are divided, the result is always smaller then them.*

Your opinion on Rafi and Ami's statement is….

A. Ami is right
B. Rafi is right
C. Both are correct
D. Two-two is wrong

B. Item 8: Verbal Representation

Mom has $\frac{3}{4}$ kg of flour in stock. To increase her supply, she bought $1\frac{1}{3}$ kg more of flour. Now, Mom's flour inventory is …

A. $4\frac{3}{2}$
B. $3\frac{1}{6}$
C. $2\frac{1}{3}$
D. $2\frac{1}{12}$

C. Item 2: Symbolic Representation

Figure 2. Mathematical representation ability test questions

quantitative variables with the following hypothesis:

(Ho): ρ= 0 (There is no correlation between students' engagement and mathematical representation ability through realistic mathematics education-based differentiated learning)

(Ha): ρ> 0 (There is a correlation between students' engagement and mathematical representation ability through realistic mathematics education-based differentiated learning)

▪ RESULT AND DISSCUSSION

Student Engagement of School A and School B

The descriptive analysis of student engagement at School A and School B is presented in Table 3.

Table 3. Descriptive analysis of student engagement of school A and school B

Analysis	School A	School B
Mean	81	78
Std. Deviation	8.98	9.95
Minimum	66	60
Maximum	97	96

Table 3 shows that the average ($\bar{x}$) student engagement of School A is higher than School B. However, the standard deviation (s) of School B is greater than School A, which indicates that the variation or spread of student engagement scores at School B is more diverse than that of School A. The percentage of cognitive, behavioural, emotional, and social engagement is presented in Table 4.

Table 4. Percentage of student engagement at school A and school B

Student Engagement	Percentage of School A	Percentage of School B
Cognitive engagement	82%	79%
Behavioral engagement	82%	82%
Emotional engagement	83%	76%
Social engagement	79%	73%

Based on the data presented in Table 4, the social engagement of School A students only reached 79%. This percentage is lower than cognitive, behavioural, and emotional engagement. At School B, students' social engagement also had the lowest percentage compared to other types of engagement, which amounted to 73%. This data shows that, in both School, social engagement is the aspect with the lowest percentage compared to other types of engagement.

Mathematical Representation Ability of Students of School A and School B

The descriptive analysis of the mathematical representation ability of students of School A and School B is presented in Table 5.

Table 5. Descriptive analysis of mathematical representation of school A and B

Analysis	School A	School B
Mean	69	69
Std. Deviation	16.486	15.04
Minimum	66	60
Maximum	97	96

Based on Table 5, the average mathematical representation ability of students in School A and School B is the same, which is 69. However, there are differences in the data distribution as indicated by the standard deviation value. School A has a standard deviation of 16.486, while School B is 15.04, which indicates that the variation in students' abilities in School A is slightly greater than in School B.

Students' mathematical representation ability is classified into visual, symbolic and verbal representations. The percentage of mathematical representation ability is presented in Table 6.

Table 6. Percentage of mathematical representation of students of school A and school B

Students' Mathematical Representation Ability	Persentage of School A	Persentage of School B
Visual Representation	71%	69%
Symbolic Representation	67%	67%
Verbal Representation	74%	76%

Based on the data presented in Table 6, students' mathematical representation ability in School A and School B showed variations in three representation types: visual, symbolic, and verbal. School A students have prominent visual representation ability, with a percentage of 71%, indicating that students can understand and convey mathematical concepts effectively through pictures, diagrams, or graphs. Meanwhile, in School B, students' verbal representation ability is more prominent, with a percentage of 76%, which shows that students have an excellent ability to describe mathematical ideas or concepts verbally. In symbolic representation, the percentage of students' ability in both School s is the same, 67%. This similarity shows that students' ability to use mathematical symbols to solve problems is equal in School A and School B. These results indicate that each School has an advantage in certain types of representation, while the ability of symbolic representation is relatively equal in both Schools.

Correlation of Engagement and Mathematical Representation Ability of School A and School B

The correlation test aims to determine whether there is a relationship between engagement and students' mathematical representation skills. Before conducting the correlation test, a normality test was conducted first to ensure that the data was normally distributed. Data normality testing was performed using the Kolmogorov-Smirnov test. The results of the test are presented in Table 7 and Table 8.

Table 7. Kolmogorov-Smirnov test of school A

		Student Engagement of School A	**Mathematical Representation Ability of School A**
N		33	33
Normal Parameters	Mean	80.91	69.39
	Std. Deviation	8.904	16.759
Most Extreme Differences	Absolute	0.141	0.181
	Positive	0.140	0.122
	Negative	-0.141	-0.181
Kolmogorov-Smirnov Z		0.807	1.040
Asymp. Sig. (2-tailed)		0.533	0.229

Table 8. Kolmogorov-Smirnov test of school B

		Student Engagement of School B	**Mathematical Representation Ability of School B**
N		31	31
Normal Parameters	Mean	78.03	69.35
	Std. Deviation	9.888	15.041
Most Extreme Differences	Absolute	0.162	0.152
	Positive	0.162	0.152
	Negative	-0.108	-0.148
Kolmogorov-Smirnov Z		0.902	1.848
Asymp. Sig. (2-tailed)		0.389	0.468

Based on the results of the Kolmogorov-Smirnov test, it can be concluded that both the mathematical representation ability of students of School A and School B and the engagement of students of School A and School B have a significance value greater than 0.05, which states that the data is usually distributed. Thus, data analysis can be continued using the Pearson correlation test to analyze the relationship between engagement and mathematical representation ability. The correlation test results between engagement and students' mathematical representation ability are presented in Table 9 and Table 10.

Table 9. Correlation test of engagement and mathematical representation ability of students of school A

		Student Engagement of School A	Mathematical Representation Ability of School A
Student Engagement of School A	Pearson correlation	1	0.760
	Sig. (2-tailed)		0.000
	N	33	33
Mathematical Representation Ability of School A	Pearson correlation	0.760	1
	Sig. (2-tailed)	0.000	
	N	33	33

Table 10. Correlation test of engagement and mathematical representation ability of students of school B

		Student Engagement of School B	Mathematical Representation Ability of School B
Student Engagement of School B	Pearson correlation	1	0.753
	Sig. (2-tailed)		0.000
	N	31	31
Mathematical Representation Ability of School B	Pearson correlation	0.753	1
	Sig. (2-tailed)	0.000	
	N	31	31

The results of the Pearson correlation test at School A and School B shows that the significance value obtained is 0.000< 0.05, then H_0 rejected, meaning that there is a correlation between student engagement and mathematical representation ability of students through RME-based differentiated learning on fraction material at School A and School B. The correlation between student engagement and mathematical representation ability is also presented in Figure 3 and Figure 4.

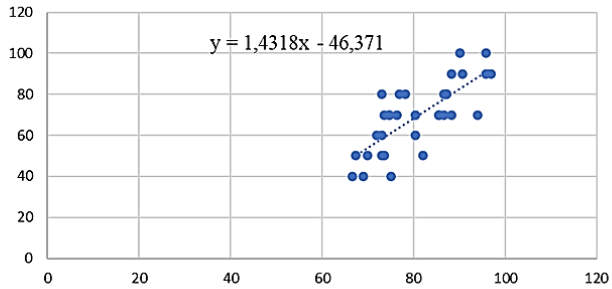


Figure 3. scatter plot of student engagement and mathematical representation ability of school A

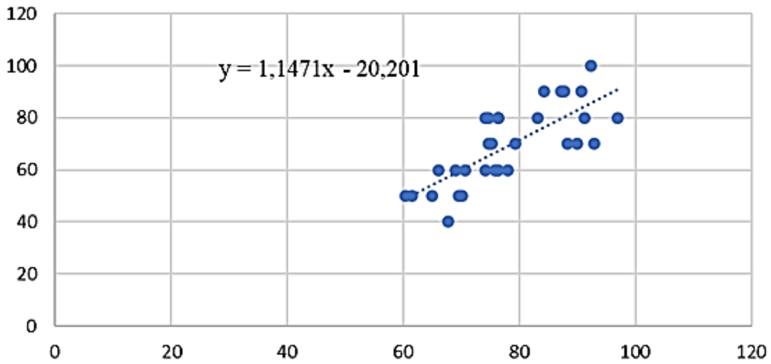


Figure 4. Scatter plot of student engagement and mathematical representation ability of school B

Based on Figure 3 and Figure 4, there is a positive relationship between student engagement and mathematical representation ability in School A and School B. Figure 3 shows the regression equation is y=1.4318x-46.371, indicating that every unit increase in student engagement at School A tends to increase mathematical representation ability by 1.4318 units. Furthermore, Figure 4 shows the regression equation is y=1.1471x-20.201, indicating that in School B, an increase of one unit of student engagement increases representation ability by 1.1471 units.

The research results from School A and School B showed a positive and significant relationship between student engagement and students' mathematical representation skills in differentiated learning based on RME, which means that the higher student engagement in the learning process, the better students' mathematical representation skills. Tomlinson (2001) said that differentiated learning is based on the principle that every child has the potential to learn according to their character, which adjusts to the level of readiness, interest, and learning preferences, while encouraging collaboration between students from various backgrounds so that students are involved in learning. Gravemeijer (1994) said that RME is a mathematics learning approach that focuses on the use of real-world contexts as a starting point in the teaching and learning process so that this approach supports students' learning readiness starting with the situation, model-of, model-for, and formal knowledge which can help students improve their mathematical representation skills through a process that is easy to understand step by step. At the situation level, students are given contextual problems relevant to everyday life. With this approach, students are actively involved and able to develop mathematical representation skills. These results support the importance of student engagement in learning, especially in using differentiated e-modules based on Realistic Mathematics Education (RME) on fraction materials in junior high School.

Student engagement is an involvement that can be described as students' interest, optimism, attention, enthusiasm, and great curiosity in the learning process (Charkhabi et al., 2019). Meanwhile, Trowler (2010) stated that student engagement is an interactive process involving time, effort, and resources dedicated by students and their institutions to maximize students' learning experiences, improve learning outcomes, develop students' full potential, and improve the performance and reputation of institutions. Winkel (1996) stated that students must be involved in learning by actively interacting and doing mental activities without needing physical movements or activities involving mental processes.

Student engagement can be seen from the behaviour of students who are emotionally involved with teachers, School s, friends, and learning activities at School, such as participation in extracurricular activities, achieving good academic grades, and positive beliefs and perceptions of themselves, School s, teachers, and friends (Jimerson et al., 2003). Student engagement expressed by Wang et al. (2016) consists of four aspects, namely cognitive engagement, behavioural engagement, emotional engagement, and social engagement.

The analysis of student engagement data shows that RME-based differentiated learning effectively increases student engagement. This result is also in line with the opinion of Panjaitan et al. (2022) that the Realistic Mathematics Education (RME) approach is one of the right approaches to designing an effective differentiated learning process; this learning approach presents contextual problems from everyday life; making it easier for students to understand and connect mathematics with their real experiences so that the learning process becomes more meaningful and fun. Although students were involved in the learning process individually, such as completing tasks (cognitive), showing discipline and activeness during learning (behaviour), and having a positive emotional response to the material and classroom atmosphere (emotional), social interaction between students in learning activities is still less than optimal because these students were in the transition period from elementary School to junior high School in semester 1 of grade 7; therefore, students did not fully know each other with their classmates. Zakiyah et al. (2010) revealed that the transition from elementary School to junior high School occurs when many physical, cognitive, and social changes occur in individuals and occur simultaneously. The seventh-grade students who experience the transition period from elementary School to junior high School experience the "top-dog phenomenon", which is a state of moving from the top position (the condition of students being the oldest, largest, and most powerful in School) at elementary School to the lowest position (students being the youngest, smallest and weakest) at junior high School. The ability of students to adjust had a considerable influence on the state of students to respond to every situation they face. Fatimah (2006) said that students' physical, mental and emotional conditions are influenced by how they can adjust to their environment. Students who have made reasonable adjustments can face difficult circumstances with positive solutions.

The results showed differences in students' mathematical representation abilities between School A and School B. In School A, students' mathematical representation ability was dominated by visual representation and low in verbal representation. In comparison, in School B, students' verbal representation ability was more prominent but low in visual representation. This difference relates to student characteristics, where School A consisted of male and female students, while School B only consisted of female students. This finding aligns with the opinion of Maccoby and Jacklin (1974), who stated that women tend to have higher verbal abilities than men, while men are superior in visual-spatial abilities.

The low verbal representation ability at School A was caused by students who had not read the problem correctly or did not fully understand the problem given, so they could not draw the correct conclusions from the answers that have been compiled. Mulyaningsih et al. (2020) revealed that many students have not fulfilled the verbal representation indicators because many still have not been able to provide conclusions from the answers given appropriately. In addition, Herlina et al. (2017) in their research also stated that students' low verbal representation skills were due to students rarely using verbal representations in the problem-solving process.

The low visual representation ability at School B was due to students' lack of accuracy in reading problems, which is in line with Yusepa (2017), who states that not being careful when reading story problems can make students feel difficult when they want to make pictures to clarify problems. According to Arcavi (2003), visualization plays an important part in constructing the mind, understanding and concretizing abstract thoughts to solve math problems. Students must be able to represent a problem using the correct mathematical expression model. Mastuti (2017) stated that students are considered understand of a concept if they can represent concepts in the form of concrete objects, images and symbolic forms.

This finding confirms the importance of encouraging students' active engagement in learning, especially through innovative approaches such as RME-based differentiated learning. This strategy encouraged students to be actively involved in learning and impacted students improved mathematical representation skills.

▪ CONCLUSION

The results of this study indicate that RME-based differentiated learning contributes positively to student engagement and mathematical representation ability. This research implies that an RME-based differentiated learning strategy can be an effective alternative to increase student engagement and have an impact on increasing students' mathematical representation ability. Student engagement at School A and School B showed that social engagement had the lowest percentage compared to cognitive, behavioural, and emotional engagement. Students' mathematical representation ability had the same average. Students' mathematical representation ability in School A was higher in visual representation, while School B wass higher in verbal representation. For symbolic representation, students' ability in both School s was at the same level. The correlation test results show a positive and significant relationship between student engagement and students' mathematical representation skills at School A and School B. Thus, the higher the student engagement, the better the mathematical representation ability.

The limitation of this study is that social interaction between students in learning activities was still less than optimal due to the transition period from elementary School to junior high School in grade 7; students did not fully know each other and were not too familiar with their friends, so students had difficulty communicating and working together in groups. Therefore, teachers should reward students who are active, caring, and able to work well together in groups. Suggestions for future research are to conduct research involving more School s or regions to expand the generalization of the results. It is also important to conduct in-depth research on factors that influence student engagement, such as motivation, learning environment, and the role of parents. Thus, learning can be continuously improved to support students' overall engagement and learning achievement.

▪ ACKNOWLEDGMENT

The authors would like to express their sincere thanks to the junior high School s in Banda Aceh, Indonesia and to the team of the Research Center of Realistic Mathematics

Education at Universitas Syiah Kuala. We would like to express our deepest gratitude for providing research grant through the research grant from Universitas Syiah Kuala scheme Penelitian Lektor number 292/UN11.2.1/PG.01.03/SPK/ PTNBH/2024.

▪ REFERENCES

Arantini, A., Tindangen, M., & Rizki, N. A. (2024). *Penerapan pembelajaran berdiferensiasi untuk meningkatkan keterlibatan siswa kelas X SMKS GKE Agri Karya Bakti dalam pembelajaran matematika konten barisan aritmatika dan geometri tahun ajaran 2023/2024.* Jurnal Inovasi Refleksi Profesi Guru, 1(1), 15–20.

Arcavi, A. (2003). The role of visual representation in the learning of mathematics. Educational Studies in Mathematics. Proceedings of the XXI Conference on the Psychology of Mathematics Education, North American Chapter, Mexico, 52(3), 215–241. https://doi.org/10.1023/A

Brenner, M. E., Mayer, R. E., Moseley, B., Brar, T., Durán, R., Reed, B. S., & David Webb. 1997. "Learning by understanding: The role of multiple representations in learning algebra". American Educational Research Journal Winter. 34(4), 663-689.

Charkhabi, M., Khalezov, E., Kotova, T., S Baker, J., Dutheil, F., & Arsalidou, M. (2019). School engagement of children in early grades: Psychometric, and gender comparisons. PLOS ONE, 14(11). https://doi.org/10.1371/journal.pone.0225542

Chee, K. H., Pino, N. W., & Smith, W. L. (2005). Gender differences in the academic ethic and academic achievement. College Student Journal, 39, 604–618.

Chotimah, B. K. (2018). Pengaruh model pembelajaran dan minat siswa terhadap hasil belajar matematika. GAUSS: Jurnal Pendidikan Matematika, 1(1), 16. https://doi.org/10.30656/gauss.v1i1.639

Dahlan, A. H. (2019). *Pengembangan model pembelajaran pendekatan matematika realistik Indonesia (PMRI) untuk meningkatkan ketertarikan belajar matematika.* JUPITEK: Jurnal Pendidikan Matematika, 1(1), 8–14. https://doi.org/10.30598/jupitekvol1iss1pp8-14

Dahlan, M., Setianingsih, R., & Sugianto, A. (2024). *LKPD CRT bangun ruang sisi datar: Upaya meningkatkan kemampuan representasi matematis siswa.* Jurnal Ilmia Pendidikan Dasar, 09(02). https://doi.org/10.23969/jp.v9i2.14015

Fatimah, E. (2006). *Psikologi perkembangan: perkembangan peserta didik.* Bandung: Pustaka Setia

Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. Review of Educational Research, 74(1), 59–109.

Graciella, M., & Suwangsih, E. (2016). *Penerapan pendekatan matematika realistik untuk meningkatkan kemampuan representasi matematis siswa.* Metodik Didaktik, 10(2). https://doi.org/10.17509/md.v10i2.3180

Gravemeijer, K. P. E. (1994). Developing realistic mathematics education. Freudenthal Institute. https://research.tue.nl/en/publications/developing-realistic-mathematics-education

Herlina., Yusmin, E., & Nursangaji, A. (2017). *Kemampuan representasi matematis siswa dalam materi fungsi di kelas VIII SMP Bumi Khatulistiwa.* Jurnal Pendidikan Dan Pembelajaran Untan, 6(10).

Jimerson, S. R., Campos, E., & Greif, J. L. (2003). Toward an understanding of definitions and measures of School engagement and related terms. California School Psychologist, 8, 7–27.

Kusumawardani, H. D. (2019). *Representasi matematis peserta didik dalam menyelesaikan masalah matematika ditinjau dari gaya kognitif impulsive-reflective.* Jurnal Ilmiah Pendidikan Matematika, 8(2). https://doi.org/10.26740/mathedunesa.v8n2.p110-116

Lette, I., & Manoy, J. T. (2019). *Representasi siswa SMP dalam memecahkan masalah matematika ditinjau dari kemampuan matematika.* MATHEdunesa, 8(3), 569–575. https://doi.org/10.26740/mathedunesa.v8n3.p569-575

Maccoby, E. E., & Jacklin, C. N. (1974). Psychology of sex differences. Stanford: Standford University Press

Mastuti, A. G. (2017). *Representasi siswa sekolah dasar dalam pemaaman konsep pecahan.* Jurnal Matematika dan Pembelajaran, 5(2), 1–16. https://doi.org/10.33477/mp.v5i2.234

Mulyadi, N. A., & Fiangga, S. (2022). *Analisis kemampuan representasi siswa dalam menyelesaikan soal materi bangun datar.* Jurnal Edukasi Pendidikan Matematika, 9(2), 143–152. https://doi.org/10.25139/smj.v9i2.3938

Mulyaningsih, S., Marlina, R., & Effendi, K. N. S. (2020). *Analisis kemampuan representasi matematis siswa smp dalam menyelesaikan soal matematika.* JKPM (Jurnal Kajian Pendidikan Matematika), 6(1), 99. https://doi.org/10.30998/jkpm.v6i1.7960

NCTM. (2000). Principles and standards for School mathematics. Reston: The National Council of Teachers of Mathematics, Inc.

Nelfita, N. (2023). *Upaya peningkatan aktivitas belajar siswa pada mata pelajaran matematika melalui model pembelajaran student teams schievement divisions di SMAS PGRI 2 Kota Jambi.* PAEDAGOGY : Jurnal Ilmu Pendidikan dan Psikologi, 3(1), 49–54. https://doi.org/10.51878/paedagogy.v3i1.2091

Nizam. (2016). *Ringkasan Hasil-hasil Asesmen Belajar dari Hasil UN, PISA, TIMSS, INAP.* Puspendik.

Panjaitan, N., Lumbantobing, M. T., & Sibagariang, S. A. (2022). *Pengaruh model pembelajaran realistis mathematics education (RME) terhadap hasil belajar matematika di kelas VI SD Negeri No.121308 Pematang Siantar.* Cendikia : Media Jurnal Ilmiah Pendidikan, 13(1), 112–122.

Ramadhani, L., Johar, R., & Ansari, B. I. (2021). *Kemampuan komunikasi matematis ditinjau dari keterlibatan siswa melalui pendekatan realistic mathematics education (RME).* AXIOM : Jurnal Pendidikan dan Matematika, 10(1), 68. https://doi.org/10.30821/axiom.v10i1.8825

Schunk, D. H. (2012). Learning theories: An educational perspective (6th ed). Pearson.

Sucipto, M. F., & Firmansyah, D. (2021). *Analisis minat belajar siswa SMP pada pembelajaran matematika.* MAJU, 8(2), 376–380. https://doi.org/10.22460/jpmi.v4i4.p799-808

Tomlinson, C. A. (2001). How to differentiate instruction in mixed-ability classrooms. 2nd edition. Association for Supervision and Curriculum Development. https://eric.ed.gov/?id=ED451902

Trowler. (2010). Student engagement literature review. ResearchGate. https://www.researchgate.net/publication/322342119_Student_Engagement_Literature_Review

Wang, M.-T., Fredricks, J. A., Ye, F., Hofkens, T. L., & Linn, J. S. (2016). The math and science engagement scales: Scale development, validation, and psychometric properties. Learning and Instruction, 43, 16–26. https://doi.org/10.1016/j.learninstruc.2016.01.008

Watson, A. (2007). The nature of participation afforded by tasks, questions and prompts in mathematics classrooms. Research in Mathematics Education, 9(1), 111–126. https://doi.org/10.1080/14794800008520174

Widakdo, W. A. (2017). Mathematical representation ability by using project based learning on the topic of statistics. In International Conference on Mathematics and Science Education (ICMScE) (pp. 1–7).

Winkel, W. S. (1996). *Psikologi pengajaran (Yogyakata)*. Media Abadi. https://library.fip.uny.ac.id/opac/index.php?p=show_detail&id=6359

Yuhaniz, M., Samsudin, N. S., Ismail, I., & Mohd Zaki, M. Z. (2018). Student engagement, collaboration and critical thinking through a board game module in an architecture history class. Idealogy Journal, 3(2), 79–86. https://doi.org/10.24191/idealogy.v3i2.77

Yusepa, B. (2017). *Kemampuan abstraksi matematis siswa sekolah menengah pertama (SMP) kelas VIII.* Symmetry: Pasundan Journal of Research in Mathematics Learning and Education. https://doi.org/10.23969/symmetry.v1i1.233

Zakiyah, N., Hidayati, F. N. R., & Setyawan, I. (2010). *Hubungan antara penyesuaian diri dengan prokrastinasi akademik siswa sekolah berasrama SMPN 3 Peterongan Jombang*. Jurnal Psikologi Undip, 8(2), 156–167.

Zulfah, Z., & Rianti, W. (2018). *Kemampuan komunikasi matematis peserta didik melalui soal PISA 2015*. JIPM (Jurnal Ilmiah Pendidikan Matematika), 7(1), 49. https://doi.org/10.25273/jipm.v7i1.3064