Implementation of Realistic Mathematics Education to Support Independent Curriculum

Tuti Zubaidah, Suhartati Suhartati, Cut Khairunnisak*, Khairul Umam, and Cut Nadia Rachmi

Department of Mathematics Education, Universitas Syiah Kuala, Banda Aceh, Indonesia
cut.khairunnisak@usk.ac.id

Abstract. The Independent Curriculum (Kurikulum Merdeka) provides opportunities for educators to create quality learning based on students' needs and learning environment. One teaching approach relevant to support the Independent Curriculum is realistic mathematics education (RME). This study aimed to describe the implementation of RME in supporting the Independent Curriculum, which is based on teachers' perceptions toward RME and Independent Curriculum, preservice teachers' abilities in teaching, and students' learning outcomes. The subjects of this study were a preservice mathematics teacher, a mathematics teacher and 25 Year 7 students at one of the public schools in Banda Aceh, Indonesia. The instruments used in this study were semi-structured interview guidelines, observation sheets, and student learning outcome tests. The data from the observation sheet and interview were analyzed descriptively, while data from the test were analyzed qualitatively using a one-tailed t-test. The results showed that the teacher perceived that using real problems as a starting point in teaching mathematics could help students achieve the learning objectives required by the Independent Curriculum. Furthermore, the preservice teachers' ability to teach using RME reached the good category and students reached mastery of learning. Thus, the RME approach is a proper approach to support the Independent Curriculum.

Keywords: Independent Curriculum, Kurikulum Merdeka, Realistic Mathematics Education (RME), Students' Learning Outcome, Teacher's Ability, Teacher's Perception.

1 Introduction

As the contemporary era advances, it becomes imperative to make adjustments, and one such area necessitating reform is the education system within schools. The Indonesian curriculum, Independent Curriculum, represents a novel policy introduced by the Republic of Indonesia's Ministry of Education, Culture, Research, and Technology [1]. Enacted in 2020 under the initiative of Indonesia's Minister of Education, Nadiem Makarim, the Kurikulum Merdeka, translating to the "Independent Curriculum," distinctly underscores the focus on granting students' autonomy in their learning processes.

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During the COVID-19 pandemic, education shifted from traditional face-to-face classes to a home-based learning model. The Independent Curriculum represents a pioneering innovation that introduces flexibility into the home learning process, offering students valuable learning experiences without the stringent requirements of completeness and graduation standards [2]. This flexibility extends beyond the pandemic, providing students with the freedom to learn from any location. Moreover, Independent Curriculum empowers educators by granting them autonomy to develop learning materials tailored to the specific characteristics and needs of their students.

The implementation of Independent Curriculum holds the promise of enhancing the overall quality of education, particularly in the realm of mathematics [3]. In order to achieve the goal of the Independent Curriculum, it is necessary to develop instructional materials that can 1) facilitate and ensure students have enough time to explore concepts and strengthen learning competencies; 2) provide freedom for teachers to choose teaching materials that suit the needs and characteristics of their students; and 3) strengthen the Profil Pelajar Pancasila (Pancasila Student Profile).

Based on the Independent Curriculum, the learning process should be personalized to meet students' needs and seamlessly integrated into their daily lives to maximize the benefits of education. One teaching approach relevant to the requirements of Independent Curriculum is Realistic Mathematics Education (RME). RME is a combination of perspectives on what mathematics is, how students learn mathematics, and how mathematics should be taught [4]. Sohilait [5] argued that RME is effective because it emphasizes the process of mathematizing everyday situations and applying mathematical concepts in real-life contexts. The term "realistic" in RME not only refers to a connection with the real world, but also to problems that most students can imagine [6]–[8].

One characteristic of RME, namely the use of real problems, enables students to apply acquired knowledge in their daily lives. The real problems in RME are meant to facilitate a reinvention process that allows students to engage with formal mathematics [9]. When abstract mathematics learning is related to students' daily experiences, the learning is saved in students' minds and can be applied in their lives [6].

Furthermore, another characteristic of RME, namely the use of students' experiences in the learning process, is important to design learning by adding cultural aspects or norms relevant to the students' surroundings in the learning process. This is also consistent with Kline's [10] viewpoint, stating that mathematics is knowledge that cannot perfectly stand on its own. However, its presence will help human activities understand social, economic, and common issues.

Therefore, this approach aligns with the goals of the Independent Curriculum, aiming to cultivate students with sharp analytical abilities, sound reasoning skills, and a comprehensive awareness of their personal development [2].

To address the issues, implementing RME becomes a crucial strategy to facilitate learning tailored to students' needs and experiences as expected by the Independent Curriculum. However, limited research was reported about how the RME approach supported the Independent Curriculum. Therefore, this study aimed to describe the implementation of RME in supporting the Independent Curriculum. In order to achieve the aim, the research questions were formulated as follows: 1) What was the teacher's perception of RME and Independent Curriculum? 2) How was the preservice teacher's

ability to conduct RME lessons? and 3) Did students' learning outcomes in an RME lesson meet the completeness criteria?

2 Method

This mixed-method research study aimed to describe teachers' perceptions of RME and Independent Curriculum, the teachers' abilities, and students' learning outcomes in an RME-based teaching setting. This study was conducted in a public school in Banda Aceh, Indonesia. The participants of this study were a mathematics teacher, a preservice mathematics teacher, and 25 Year 7 students. The study was divided into three meetings of teaching experiments followed by a test. The instructional materials for the teaching experiment were developed by the authors and met valid criteria. Table 1 summaries the learning trajectory (LT) of the teaching experiment.

Table 1. Learning trajectory of teaching experiment.

Level	Mathematical Activities	
	LT-1 (Day 1)	LT-2 (Day-2)
Situation	1. Finding and collecting information from classmates on their religious activities during Ramadhan (Using Google Forms)	1. Answering questions related to religious activities during Ramadhan through quizizz.com. 2. Collecting quizizz scores and presenting all data using a projector
Model-of	2. Finding various strategies to collect data on religious activities during Ramadhan and match the data of activities with the data collection method.	3. Answering questions related to religious activities during Ramadhan through quizizz.com. 4. Collecting quizizz scores and presenting all data using a projector
Model-for	5. Presenting the data found into a bar chart, line chart, or pie chart.	5. Comparing the mean, median, and mode.
Formal Knowledge	6. Understanding methods of data collection and data display.	6. Explain and choose measures of central tendency suitable for a data group.

The data in this study consists of qualitative and quantitative data. The qualitative data in this study was semi-structured interviews with the mathematics teacher. This interview was intended to assess teacher's perceptions of the RME and Independent Curriculum. The interview data was then analyzed descriptively.

The quantitative data were collected using a teacher activity observation sheet and students' learning outcome test. During the teaching experiment, the mathematics teacher observed the implementation of RME learning conducted by the preservice teacher and filled out the observation sheet. The teacher activity observation sheet used in this study had 14 closed statements with yes or no response options. The components were separated into six for opening activities, seven for core activities, and four for

closing activities. This teacher activity observation sheet also provided a space for observers to make essential comments about their observations. The data was then analyzed descriptively by computing the average score and its percentage. The preservice teacher's ability was then classified according to excellent, good, satisfactory, and poor. Table 2 presented the criteria proposed by Riduwan [11].

Table 2. Classification of teacher's ability.

Interval of Percentage	Criteria
$p \geq 90\%$	Excellent
$80\% \leq p < 90\%$	Good
$70\% \leq p < 80\%$	Satisfactory
$p < 70\%$	Poor

The student learning outcome tests were administered after the teaching experiment. The instrument was a test consisting of two long answer questions related to students' daily activities during Ramadhan. The test has been validated by experts. The learning outcome test data was analyzed using a one-tailed t-test using SPSS 25 after it was tested for normality. The hypotheses were as follows.

H_0: $\mu < \mu_0$ (Students learning outcome has not reached the mastery learning)
H_0: $\mu > \mu_0$ (Students learning outcome has reached the mastery learning)

3 Results and Discussion

3.1 Teacher's Perception of RME and Independent Curriculum

According to the interview, the teacher explained that RME aligns with and could support the Independent Curriculum. The teacher posited that the demand for Independent Curriculum to give students memorable experiences in the learning process could be achieved by giving real problems as the starting point in the learning process, one of the principles of the RME. Therefore, in the future, students will understand the theory and apply the mathematics knowledge to everyday life.

3.2 Preservice Teacher Ability in Implementing RME to Support the Independent Curriculum

During the teaching experiment, the preservice teacher implemented the RME approach using the instructional materials. The lesson was observed by the mathematics teacher. Fig.1 presented the observation result of the preservice teacher's ability to conduct the RME approach.

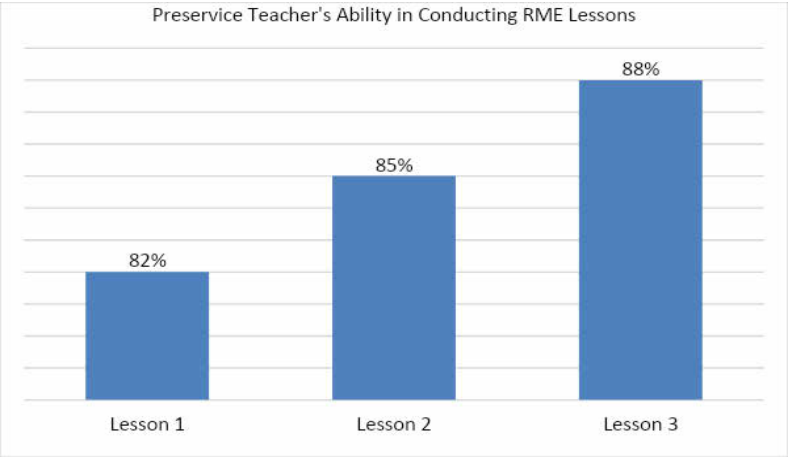

Fig. 1. The teacher's ability in conducting RME lessons.

As illustrated in Fig.1, the preservice teacher's ability met the good category at the first meeting. It continued to improve at each meeting, with the percentage at the first, second, and third meetings being 82%, 85%, and 35%, respectively. Furthermore, the teacher's overall competence achieved 85% on average, indicating that the preservice teacher's ability to conduct the RME lesson was in a good category.

3.3 Students' Learning Outcome in an RME Lesson

The student learning outcome test was performed after three RME lessons. Table 3 presents descriptive statistics on student test results.

Table 3. Descriptive statistics of students' test results.

Test Results	
Mean	79.44
Standard Error	2.189
Variance	119.840
Standard Deviation	10.947
Minimum	60
Maximum	100
Range	40
Skewness	0.387
Kurtosis	-0.200

Table 3 shows that the minimum score obtained in the test was 60 while the maximum score was 100 (M = 79.44; SD = 10.947). 80% (N=20) of students scored above the minimum competency criteria, as presented in Table 4.

Table 4. Students' learning outcome.

Description	Number of Students	Percentage
Reach the minimum competency criteria	20	80%
Not reaching the minimum competency criteria	5	20%

The next data analysis was the prerequisite test before testing the hypothesis, the normality test. It was performed using SPSS 25. The normality test results can be seen in Table 5.

Table 5. Normality test.

	Kolmogorov-Smirnov[a]		
	Statistic	df	Sig.
Score	.139	25	.200*

*This is a lower bound of the true significance
[a]Lilliefors Significance Correction

Table 5 indicates that the test data were normally distributed, then the t-test was performed using SPSS 25 as follows.

Table 6. Students' learning outcome.

Test Scores	
T	2.028
Df	24
Sig. (2-tailed)	0.054

Table 6 indicates a significant difference between the test and the minimum criteria of the advanced category (t_{25}=2.028, p=0.054). Hence, H_0 is rejected, and H_1, "Students learning outcome has reached mastery learning," is accepted.

3.4 Discussions

This study examines how the implementation of RME supports the Independent Curriculum. The findings are discussed as follows.

The students who participated in this study had mastered the RME-based learning on data display and data processing topics. This result was in line with an experiment conducted by Uyen et al. [12] which found that employing the RME approach in teaching statistics positively influenced the development of essential skills required by students. The teacher, who typically initiates teaching activities by prompting students to share their previous experiences related to the topic, identified this as a contributing factor to the student's academic achievement. She argued that this strategy enhances students' comprehension of the subsequent lesson. RME implementation has a major positive effect on the mathematical abilities of students because RME enables students

to collaborate, discuss, think, and find solutions to real-world problems [13]. Altaylar & Kazak [14] supported this argument, asserting that learning emphasizing students' understanding of mathematical concepts and their practical application in daily life is more effective in enhancing students' abilities than memorizing concepts or formulas without contextual relevance.

The preservice teacher's ability to conduct the RME lesson met the good category since the first meeting and continued to improve in each meeting. One of the reasons could be that the preservice teacher is often involved in training or workshops related to RME conducted by the PRP-PMRI USK (Syiah Kuala University Research Center of Realistic Mathematics Education) team. Teachers' involvement in RME workshops obtained knowledge of the RME-based learning trajectory after participation [8] and might increase teachers' conceptual teaching, practical teaching, mathematics content and skill, and the use of learning media within PMRI learning [15]. Furthermore, the preservice teacher was also actively involved in designing the instructional materials with the team and the authors.

The teacher asserted that Realistic Mathematics Education (RME) could effectively support the implementation of the Independent Curriculum. According to the teacher, initiating the RME approach in the teaching and learning process involves presenting students with real-world problems and creating memorable experiences aligning with the objectives of the Independent Curriculum. The teacher identified this practice as the reality principle. Additionally, beyond providing students with "real-life" problems as a starting point for applying mathematical solutions, van Heuvel-Panhuizen and Drijvers [6] stated that the reality principle also means that the starting problems offer students the opportunities to attach meaning to the mathematical constructions they generate while solving problems. These constructions, shaped by students' prior experiences, align with the assertion that Independent Curriculum is adaptable based on students' character and competence [16], [17].

4 Conclusion

The findings showed that the teacher believed that the realistic mathematics approach could support the implementation of Independent Curriculum. Furthermore, the preservice teacher's ability to teach using RME reached the good category, and 80% of students met the minimum competency criteria. This finding suggests that RME is suitable for promoting the Independent Curriculum.

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References

1. S. Mustaghfiroh, "Konsep 'Merdeka Belajar' Perspektif Aliran Progresivisme John Dewey," *J. Studi Guru dan Pembelajaran*, vol. 3, no. 1, Art. no. 1, Mar. 2020, doi: 10.30605/jsgp.3.1.2020.248.
2. M. Saleh, "Merdeka Belajar di Tengah Pandemi Covid-19," *Pros. Semin. Nas. Hardiknas*, vol. 1, pp. 51–56, May 2020.
3. G. F. Purba, A. Rohana, F. Sianturi, M. Giawa, E. Manik, and A. S. Situmorang, "Implementasi Pendekatan Pendidikan Matematika Realistik Indonesia (PMRI) pada Konsep Merdeka Belajar," *Sepren*, vol. 4, no. 01, Art. no. 01, Nov. 2022, doi: 10.36655/sepren.v4i01.732.
4. R. Johar, C. M. Zubainur, C. Khairunnisak, and T. Zubaidah, Membangun kelas yang demokratis melalui pendidikan matematika realistik. Syiah Kuala University Press, 2022.
5. E. Sohilait, "Pembelajaran matematika realistik," 2021.
6. M. van den Heuvel-Panhuizen and P. Drijvers, "Realistic mathematics education," *Encycl. Math. Educ.*, pp. 521–525, 2014.
7. D. H. Tong, T.-T. Nguyen, B. P. Uyen, L. K. Ngan, L. T. Khanh, and P. T. Tinh, "Realistic Mathematics Education's Effect on Students' Performance and Attitudes: A Case of Ellipse Topics Learning," *Eur. J. Educ. Res.*, vol. 11, no. 1, pp. 403–421, 2022.
8. C. Khairunnisak, R. Johar, S. Maulina, C. M. Zubainur, and E. Maidiyah, "Teachers' understanding of realistic mathematics education through a blended professional development workshop on designing learning trajectory," *Int. J. Math. Educ. Sci. Technol.*, Feb. 2022, Accessed: Oct. 02, 2023. [Online]. Available: https://www.tandfonline.com/doi/abs/10.1080/0020739X.2022.2038800
9. K. Gravemeijer and M. Doorman, "Context Problems in Realistic Mathematics Education: A Calculus Course as an Example," *Educ. Stud. Math.*, vol. 39, pp. 111–29, 1999.
10. M. Kline, Why Johnny can't add: the failure of the new math. Vintage Books, 1973.
11. Riduwan, Skala Pengukuran Variabel-Variabel Penelitian. Alfabeta, 2015.
12. B. P. Uyen, D. H. Tong, N. P. Loc, and L. N. P. Thanh, "The Effectiveness of Applying Realistic Mathematics Education Approach in Teaching Statistics in Grade 7 to Students' Mathematical Skills," *J. Educ. E-Learn. Res.*, vol. 8, no. 2, pp. 185–197, 2021.
13. D. Juandi, Y. S. Kusumah, and M. Tamur, "A Meta-Analysis of the Last Two Decades of Realistic Mathematics Education Approaches," *Int. J. Instr.*, vol. 15, no. 1, pp. 381–400, 2022, doi: 10.29333/iji.2022.15122a.
14. B. Altaylar and S. Kazak, "The Effect of Realistic Mathematics Education on Sixth Grade Students' Statistical Thinking," *Acta Didact. Napoc.*, vol. 14, no. 1, pp. 76–90, 2021.
15. R. Ekawati and A. W. Kohar, "Innovative Teacher Professional Development within PMRI in Indonesia," *Int. J. Innov. Sci. Math. Educ.*, vol. 24, no. 5, 2016, Accessed: Dec. 07, 2023. [Online]. Available: https://openjournals.library.sydney.edu.au/CAL/article/view/9102
16. D. Irawati, H. Najili, S. Supiana, and Q. Y. Zaqiah, "Merdeka Belajar Curriculum Innovation and Its Application in Education Units," *Edumaspul J. Pendidik.*, vol. 6, no. 2, pp. 2506–2514, 2022.
17. "Permendikbud No. 22 Tahun 2020," Database Peraturan | JDIH BPK. Accessed: Nov. 09, 2023. [Online]. Available: http://peraturan.bpk.go.id/Details/163750/permendikbud-no-22-tahun-2020