

Research Article

Improving the ability to understand the concept of building space through PMRI-based with the help of smart classroom applications for students of primary school

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ABSTRACT

The quality of education must be improved in order to create quality education. The Covid-19 virus that has infected most Indonesians since early March 2020 has impacted all areas of community movement. Restrictions on personal activities until the Implementation of Community Activity Restrictions (PPKM) began to be enforced. Physical distancing is one of the efforts made to limit community interaction. The government also decided to disburse students and shift schools' teaching and learning process to at home. Distance learning or online learning requires all school residents to work more actively in teaching and learning activities. The ability to understand concepts is one of the skills that are expected to be achieved in mathematics subjects. This study aims to determine the application of learning with the PMRI Approach assisted by the Smart Classroom application in improving the ability to understand the concept of building a classroom for grade V students of SDN Jakamulya III Bekasi City. This research was conducted quantitatively with 6 subjects as the object of study. The results of the study show that there is an increase in mathematics learning with the PMRI approach with the help of the Smart Classroom application. The results showed that the PMRI approach assisted by the Smart Classroom application for mathematics subjects in grade V elementary schools could help students understand the concept of building spaces. This is shown by the increase in positive responses from the start of cycles I, II, and III in scoring and interviews. Students are happy and facilitate learning through the Smart Classroom app. Moreover, there are online and offline learning systems and hybrid learning.

Keywords: Concept of Building Space; Elementary School; Primary School; Smart Classroom Application; PMRI

1. INTRODUCTION

The development of digital technology is making changes in all fields, one of which is the field of education—coupled with Covid-19 that hit the whole world in early 2020. The emergence of digital applications bored the current generation with learning systems that do not adapt too quickly to the current situation. Social Media, Tiktok, and Youtube applications add to students' perceptions of learning methods that are considered boring. Educators of different generations also inevitably follow the rapidly developing technological developments.

Based on observations made in mathematics learning in class V of SDN Jakamulya III Bekasi City, there are various learning obstacles: (1) Students are not interested in the material presented by the teacher. The lack of mastery of the teacher in varying the methods used triggers students' disinterest in the subject matter presented. (2) The low ability to understand students' mathematical concepts is indicated by low learning outcomes and classical completion percentages of less than 75%. Based on the results of the daily assessment, it can be seen that the acquisition of student scores that reached and exceeded the Minimum Completion Criteria (KKM) 75 was only 8 out of 30 students or only 26.67%. (3) Learning is still dominated by the lecture method to explain formulas through video conference and continued with the work of question exercises in the student handbook so that learning is less varied. The learning routine allows students to solve problems based on the teacher's explanation. Students will find it difficult if the variations of the questions are replaced because the formulas used are not based on concepts that are the result of their findings.

Indonesian Realistic Mathematics Education (PMRI) is a practical approach to help understand concepts and student activity in learning (Pitaloka, Susilo, & Mulyono, 2012). With the characteristics of the use of context and the use of models, students can contribute to building their thinking in forming a concept. PMRI directs students to find a concept by using

the student's initial knowledge associated with the material being studied. The existence of interactions both with teachers and with fellow students can strengthen their findings so that concepts can last a long time in memory.

The Smart Classroom application is an interactive learning media that quickly presents the stages of learning so students can understand a concept. A deeper understanding of mathematics learning will be directed with a PMRI approach assisted by the Smart Classroom Application so that it can affect students' mathematical concept understanding ability. The purpose of the study was to determine the application of learning with the PMRI Approach assisted by the Smart Classroom application in improving the ability to understand the concept of building a room for grade V students of SDN Jakamulya III Bekasi City.

2. LITERATURE REVIEW

2.1 Indonesian Realistic Mathematic Education (PMRI)

PMRI, also known as Realistic Mathematic Education (RME), was initiated by Hans Freudenthal, a researcher from the Dutch University of Utrecht Research Institute. PMRI focuses on "realistic" situations as a source to initiate the development of mathematical concepts/algorithms, operations, and procedures, as well as a context that can apply students' mathematical knowledge to the next stage, which is more formal and general (Agusta, 2020). The meaning of "realistic" bridges the student to an imaginable problem situation. The interpretation of "realistic" comes from the expression "zich realiseren," which means "to imagine." (Heuvel & Drijvers, 2020). Thus, it can be said that the meaning of realistic lies not only in something context but also in a situation that the student can imagine. PMRI has three principles, namely: 1) Guided Reinvention and Progressive Matematization, 2) Didactical Phenomenology, and 3) Self Developed Model (Sembiring, 2010). In the principle of Guided Reinvention, learning begins with realistic contextual problems. Whereas on the principle of Progressive Matematization, students' thinking is directed from real problems to formal mathematics (horizontal mathematics) and continued to higher formal mathematics (vertical mathematics). With various activities, students seek to rediscover understanding, properties related to mathematical principles and functions even though the disclosure still uses informal language (Stephan, et.all., 2014).

2.2 Learning Media

1. Definition of Media

Media is not a foreign word, often heard mainly in delivering information. The word media comes from the Latin medium, intermediary or introductory. The medium is the intermediary or delivery of the message from the sender to the recipient. Gerlach et al. (1980) say that media includes humans, materials, or events that produce knowledge and attitudes. Based on the two opinions above, it can be said that the media is a tool or component used to convey messages from someone to others so that it can generate motivation in learning. According to Sardiman, et al (2008) media is a tool for channeling messages from sender to receiver that can stimulate students' thoughts, feelings, attention, interest and attention in learning. Whereas according to Gagne (in Warsita, 2018) the media is a component in the student's environment that can stimulate him to learn.

2. The Function and Role of Media in Mathematics Learning

An intermediary in the form of concrete objects (ril) is needed in understanding abstract concepts. The understanding of new abstract concepts will easily precipitate, cling to, and last if he learns by doing and understanding understanding, not just through memory (Agusta, 2020). Arsyad (2017) added that with the medium of conveying information becoming clearer, students' attention to the material could also be directed. Meanwhile, students' experience in associating concepts with their daily lives can add to students' understanding of what is being learned. With the use of learning media, students become creative in developing ideas, helping to understand, and communicating. The types of learning media can be text, audio, visual, motion projection, and miniatures (Smaldino et al., 2005). Based on some of the above opinions, it can be said that the medium of desire, motivation, stimulus, and desire that is new in learning can be aroused. In addition, the media can also provide an integrated experience from a concrete problem to an abstract one so children's ideas and understanding can develop.

3. Smart Classroom App

Learning applications are a form of utilizing technology in the world of education. The use of technology in learning keeps students motivated by what they learn and shows significant positive attitude changes (Omer & Hayran, 2015). With technological devices, students have the opportunity to learn on their own without fear of making mistakes during the learning process (Iskandar, et al, 2020). Programs operated in an operating system environment related to learning applications are used to solve specific problems with a particular scope determined by the creator (Prasesti, 2015). One of the learning applications, namely Kelas Pintar, allows teachers and students to organize teaching and learning activities online with a learning experience like in school. One of the Smart Classroom application's features is a school with six menus: Class, Homework (HOMEWORK), Project, Assignments, Exams, and Monitoring. In the Class menu, the teaching and learning process can be like in the classroom, carried out virtual face-to-face to allow interaction between teachers and students and between students. This menu also provides a virtual whiteboard that can be used by teachers and students to ask questions and explain the material. An activity log is a place where teachers can review and manage student learning activities. To measure students' abilities, teachers can use the Exams menu. In addition to providing a question bank that

the national curriculum has standardized, this menu also provides facilities for reporting exam results in real-time. As a follow-up to the evaluation, teachers can use the Tasks menu to carry out remedial and enrichment programs. Observation and supervision of student learning activities can also be done on the Monitoring menu. This supervision will be recorded, and the teacher will get a log of activities from the application and can see the results of the student's surveillance record report, including checking the originality of the student's answers.

2.3 The Relationship between Concept Understanding Ability and PMRI Approach assisted by Smart Classroom Applications

Mathematics learning shapes the mindset and understanding of an understanding and reasoning in a relationship of several understandings obtained through experience of existing or non-existent properties of a set of objects (Asiyah, 2012). A mathematical material that is difficult for elementary school students to understand concepts after fractions and math problems in the form of stories is geometry (Sarjiman, 2006). Geometry is a strategic mathematical study that can push towards learning mathematics that is meaningful with meaningful learning. In his theory, Jean Piaget says that elementary school students' intellectual development is in a period of concrete operations that still base understanding on concrete objects and real situations. The ability to think logically, the organization of the unity of thought, the view of the totality of structures, and to structure them in hierarchical relationships are indicators of the development of abilities at this time.

Based on the above views, one of the learning approaches that pay attention to the structure of students' thinking abilities is PMRI. In its application, PMRI pays attention to not only the object of study in the abstract but also the development of the child's soul, manifested in problem-solving steps so that it can lead students to understand abstract objects by starting from concrete things (Yuniarti, 2016). As for communicating directly online with teachers, this application provides teacher features that can guide students throughout the learning process. This application has a group feature that can be a place for students to discuss and contribute during the learning process. Further discussions related to the achievement of student discussion results can be presented in the virtual class menu that can support the characteristics of PMRI learning, namely interactivity. Using the Monitoring menu, teachers can also see student involvement in the learning process.

The essence of PMRI learning is to emphasize that students can build their thoughts and find concepts by connecting their initial knowledge with the material being studied. Therefore, the teacher needs to present the subject matter using context with animation and problems that lead students to create a model that can help them find a concept. This can be done by the teacher on the PR and Project menus. Meanwhile, to find out and analyze the extent of students' understanding of the context, teachers can take advantage of the exam menu.

2.4 Space Building Materials

The Space Building Material in this study consists of a prism with a quadrilateral and triangular base, which includes three indicators: 1) Prism volume, 2) Prism nets, and 3) Prism surface area. In teaching the concept of building this space, the context used is in the form of objects, such as the shape of the house and its roof, cabinets, refrigerators, snack boxes, and so on. With initial knowledge of building flat, which consists of two elements, namely length, and width, students are directed to find the concept of building space. Understanding will begin by first looking for the difference between waking up flat and building space until students can conclude that building space is a flat wake with a height resulting from a room in the building.

3. RESEARCH METHOD

The Approach in this study is qualitative with the method of interviewing, observing, and utilizing documents. As a type of classroom action research, the PTK procedure is carried out in research cycles consisting of four stages, namely: planning, implementation, observation, and reflection stages. The four stages are in one cycle. Reflection is the final stage that evaluates the actions carried out in the cycle on which improvements are based on the actions of the next cycle. Data analysis was carried out from the beginning of the pre-cycle, starting with pre-research tests to the final test in the research cycle. Data based on the selected instrument are analyzed to be further used to answer research problems and test hypotheses. According to Milles & Huberman (1992), the components of data analysis are divided into three, namely data reduction, data presentation, and drawing conclusions.

4. RESULTS AND DISCUSSION

1. Pre-Research

In the process of designing research instruments, researchers conduct validation tests with the help of experts in their fields, namely (1) Dr. Flavia Aurelia Hidajat, M.Pd. with a profession as a lecturer at the Mathematics Education Study Program at The State University of Jakarta, (2) Portion Manik, S.Pd. with a profession as a Principal at SD Negeri Jakamulya III Bekasi City, and (3) Yan Yan Julian, S.Pd., M.Pd. with a profession as a Mathematics Lecturer at the University of 1945 (Unisma). This aims to maximize the research process so that the research instrument can measure what is to be measured by the goals to be achieved. Meanwhile, as observers, namely (1) Dian Widyaningsih, S.Pd., M.Si. with a profession as a Mathematics Teacher at SDN Jakamulya II Bekasi City and (2) Dimas Reza Praditya with a position as Education Consultant.

This study was conducted in class V at SDN Jayamulya III Bekasi City in Mathematics lessons with an intelligent classroom application based on Indonesian Realistic Mathematics Education or PMRI. This is done as an effort to meet the needs of students in mathematics subjects. The research schedule can be seen in the **Table 1**.

Table 1. Class V Research Schedule at SDN Jayamulya III Bekasi

Day/Date	Time	Activities
February 2022	-	Pre-Research
March 2022	-	Pre-Cycle
Monday, March 28, 2022	08:00-09:40	Carrying out the first Research cycle I and Pre-Test I
Friday, April 08, 2022	08:00-09:40	Researching both Cycles I and Post-Test I
Monday, April 11, 2022	08:00-09:40	Carrying out the Third Research Cycle II and Pre-Test II
Friday, April 22, 2022	08:00-09:40	Carrying out the fourth Research Cycle II and Post-Test II
Monday, April 25, 2022	08:00-09:40	Carrying out the fifth Research cycle III and Pre-Test III
Friday, May 06, 2022	08:00-09:40	Conducting the sixth Research Cycle III and Post-Test III

2. Pre-Cycle

After conducting Pre-Research, I continued with Pre-Cycle, where three activities ranged from planning, group formation, and determination of research subjects to the socialization of PMRI to elementary school students in class V. The description of pre-cycle activities can be described in **Figure 1**.

Activity 1: Planning Phase

Teachers plan to use learning tools, namely the Smart Classroom application for mathematics subjects in class V.

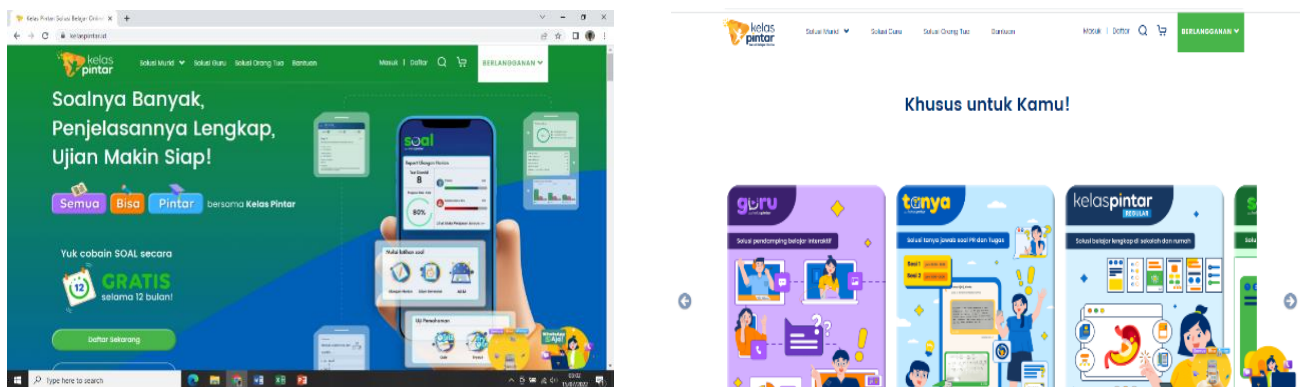


Figure 1. Smart Classroom Application Usage Planning
(Source: <https://www.kelaspintar.id/>)

Activity 2: Group Formation and Determination of Research Subjects

The research subjects (SP) observed in this study were 6 students from 30 grade V students of SDN Jatimulya III Bekasi City. These six SP people consist of 2 upper group students with above-average abilities, 2 medium group students with average abilities, and 2 lower group students with below-average abilities. The SP selection criteria are based on the results of pre-research tests that show the initial ability of the student. In the upper group, 2 students with the highest scores were selected as SP. Meanwhile, 2 students were randomly selected in the middle group because their pre-research test results tended to be the same. The selection of sp in the middle group is seen in how students answer the questions. This is important to support the results of the observations that will be made. As for the lower group, 2 students with the lowest scores were chosen to be SP to see an increase better or not after pmri learning was carried out with the help of Smart Class. Researchers assume that if students with the lowest scores can participate in PMRI learning and have an impact on increasing understanding of the concept, it is certain that PMRI learning also impacts students in the lower, middle, and upper groups. The selection of SP does not affect the division of sessions in students, meaning that it can be possible if the number of SP in each session is not the same, and there is also a possibility if the students of the upper and middle groups or students of the middle and lower groups are in session I or vice versa.

Activity 3: Socialization of Indonesia's Realistic Mathematics Approach

In this activity, class V students are expected to use laptops or cellphones with quotas that can access the network, then asked to download the intelligent class application. The teacher continued to teach the procedures for logging in to follow the subject of Mathematics class V with the material from the Building Room.

3. Cycle I

Overall, from the observations, data were obtained that student learning activities at each step in the learning process in -

the first action cycle have not shown the expected student learning activity. The achievement of student learning activities in the first cycle can be seen in the **Table 2**.

Table 2. Results of Observation of Student Activity Cycle I

No.	Subject Name	Cycle I	Informations
1	Subject 1	5	Less Active
2	Subject 2	8	Less Active
3	Subject 3	10	Moderately Active
4	Subject 4	11	Moderately Active
5	Subject 5	16	Active
6	Subject 6	19	Active
	Average	11,5	Moderately Active

Based on the **Table 2**, it can be seen that the acquisition of student learning activities in the first cycle, namely, students who can be categorized as active are only 2 students as much as 11.5% of the number of subjects, while 2 students are still in the category of quite active, and the other 2 students are in the category of less active. As for the average student activity, it is still in the category of quite active. Based on the results of these data, action is needed in the next cycle so that the desired activeness criteria can further increase student learning activity. In the implementation of this first cycle, the implementing teacher and researchers are still not satisfied with the results achieved by students. From the results of these reflections, several shortcomings were obtained with the following details: 1). Students still feel unfamiliar and unfamiliar with the use of technological approaches, so some students are still hesitant and shy in asking their questions or answering the questions given, 2). The presentation slides that researchers made are still too verbal, 3). In the implementation of learning, the implementing teacher can still not provide motivation and guidance to his students to be more active in learning, 4). Students are still tricky with the Covid-19 condition both offline and online after 2 years of impact slightly disrupting student learning in receiving Mathematics subject matter, plus group learning is still limited by government regulations, 5). Technical obstacles to the use of Smart Classroom technology applications, both networks, student concentration abilities, and other obstacles.

4. Cycle II

In addition to student learning activities in cycle II, progress is left. There is 1 less active student. From these data, it can be seen that there is positive progress in student learning activities. Comparison of student activities in cycle I and cycle II can be seen in the **Table 3**.

Table 3. Comparison of Student Activities in Cycle I and Cycle II

Category	Results of Increased Student Learning Activity	
	Cycle I	Cycle II
Very Active	-	-
Active	2 students	2 students
Moderately Active	2 students	3 students
Less Active	2 students	1 student
Very Less Active	-	-
Achievement	66.67% (4 out of 6 students)	83.33% (5 out of 6 students)

Based on the **Table 3**, there was a positive response from students related to learning even though only 1 student was less active, but of all the students who were the study subjects, only one of the students obtained the data as expected. Therefore, it is necessary to carry out further research. Not much different from siklus I, in each learning activity carried out by researchers and teachers. In implementing this second cycle, teachers and researchers are still not satisfied with the results obtained. From the results of the reflection, several shortcomings were obtained as follows: 1). The Smart Classroom application had been up and down constrained by the network or signal, 2). Class conditions are less conducive considering that there are two parts of online classes and offline classes, so that the learning atmosphere becomes different and the teacher becomes less focused on the material presented, 3). Teachers seem to be in a hurry in delivering learning materials. The results of this reflection will be used as a reference for action planning in the next cycle, namely cycle III.

5. Cycle III

A comparison of average scores on improving student learning outcomes can be seen in **Table 4**.

Table 4. Comparison of Student Learning Outcomes

No.	Cycles	Average Post-test Score	Increased
1	Pre-tets	44	-
2	Post-test Cycle I	56	12
3	Post-test Cycle II	64	8
4	Post-test Cycle III	77	13

Based on the **Table 4**, it can be seen that the acquisition of student learning outcomes in each cycle has increased positively. Although the improvement shown is not very consistent, this shows that the more students are actively involved in the learning process, the more students can understand the learning material received, especially assisted by the Smart Classroom technology application, so that student learning can improve with a virtual learning system both with online and offline classes. The acquisition of student learning activities in cycle III there is progress left there is 1 student who is quite active. Based on these data, it can be seen that there is a positive progress in student learning activities. Comparison of student activities in cycle I, cycle II and cycle III can be seen in **Table 5**.

Table 5. Comparison of Student Activity in Cycle I, Cycle II, and Cycle III

Category	Results of Increased Student Learning Activity		
	Cycle I	Cycle II	Cycle III
Very Active	-	-	2 students
Active	2 students	2 students	3 students
Moderately Active	2 students	3 students	1 student
Less Active	2 students	1 student	-
Very Less Active	-	-	-
Achievement	66.67% (4 out of 6 students)	83.33% (5 out of 6 students)	100% (6 out of 6 students)

Based on the **Table 5**, there is a positive response from students regarding student learning who are the subject of research only as students who obtain data as expected. Learning activities in cycle III can be said to be better when compared to cycle I and cycle II. In this third cycle, action research went smoothly. Teachers, students, and researchers are happy and satisfied with the implementation of actions in this cycle. The results of the average student activity increase and exceed the desired indicators of research success. Some students began to be confident in expressing their opinions and showing their potential, and students began to get used to conveying the results of discussions in front of the class. Students are also getting used to working together in groups. The discussion group is increasingly looking compact and active.

6. Validation

A validation Test is used to determine the level of validity of the learning instrument so that the instrument can be used to measure what should be measured. To measure the validity of the test questions, the technique used is the product-moment correlation technique with the following formula:

$$r_{xy} = \frac{N \sum XY - (\sum X)(\sum Y)}{\sqrt{[N \sum X^2 - (\sum X)^2][N \sum Y^2 - (\sum Y)^2]}}$$

Description r_{xy} : correlation coefficient

X : score of each question

Y : total score

N : number of trial students

After calculations, the following results were obtained:

Table 6. Criteria for Pre-test and Post-test Score Validity Test Results

No.	Cycles	Validity			Informations
		r_{xy}	r table (5%)	Criteria	
1	Pre-test I	0,7084	0,374	Strong	Valid
2	Pre-test II	0,9282	0,374	Very Powerful	Valid
3	Pre-test III	0,755	0,374	Strong	Valid
4	Post-test I	0,7386	0,374	Strong	Valid
5	Post-test II	0,936	0,374	Very Powerful	Valid
6	Post-test III	0,8015	0,374	Very Powerful	Valid

At the level of $\alpha = 5\%$ with $n=28$ obtained t table 0.374. The table above shows that the r_{xy} coefficient score is calculated to be greater than r of the table. Thus, all the scores obtained are declared valid and can be used. The attachment of the validity of the score can be seen in the appendix.

CONCLUSION

Based on the results of study and the results of trials on the Smart Classroom Application for Mathematics Subjects based on PMRI that has been carried out at SDN Jakamulya III Bekasi City, it can be explained as follows: 1). This Class Action Research was carried out in 4 stages using a PMRI-based Smart Classroom Application for building room material for class V of SDN Jakamulya III Bekasi City, 2). The results showed an increase in learning activities with positive responses starting from cycles I, II, and III by 66.67% (cycle I); 83.33% (cycle II); and 100% (cycle III), 3). The validity of the data for pre-test and post-test shows a relatively high level of validity above 0.374 (according to the table r). This can be seen in the significant positive increase from cycle I to cycle III. As for the calculation result $r_{\text{count}} > r_{\text{table}}$, H_0 was rejected, and H_a was accepted.

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AUTHOR'S CONTRIBUTIONS

The authors discussed the results and contributed to from the start to final manuscript.

CONFLICT OF INTEREST

There are no conflicts of interest declared by the authors.

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