Sriwijaya International Journal of Lesson Study
Vol. 2, No. 1, March 2021, pp. 11-22
P-ISSN: 2722-0370; E-ISSN: 2722-3310
DOI: https://doi.org/10.36706/sij-ls.v2i1.13

Understanding the Mathematical Concepts of Students With Exponential Number through PMRI and LSLC

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Abstrak

Penelitian ini merupakan penelitian deskriptif yang bertujuan untuk mengetahui kemampuan siswa dalam memahami konsep matematika perkalian bilangan bulat dengan pendekatan PMRI dan LSLC. Subjek penelitian ini adalah siswa kelas VII (VII.C) SMP Srijaya Negara yang berjumlah 30 siswa. Ada empat tahapan LSLC dalam penelitian ini. Pertama adalah tahap desain yang disesuaikan dengan prinsip dan karakteristik PMRI. Yang kedua adalah tahap *do* (implementasi). Yang ketiga adalah tahap melihat (*see*). Terakhir adalah tahap *re-design*. Proses pembelajaran disesuaikan dengan prinsip dan karakteristik PMRI dan komunitas belajar. Teknik pengumpulan data yang digunakan dalam penelitian ini adalah tes tertulis yang terdiri dari 2 butir soal tes uraian, observasi dan wawancara diperlukan untuk memperoleh data pendukung. Berdasarkan hasil penelitian diketahui bahwa gambaran kemampuan siswa dalam memahami konsep matematika perkalian bilangan bulat dengan pendekatan PMRI dan LSLC dengan rincian sebagai berikut: pada soal nomor 1, indikator yang sering muncul adalah indikator yang menerapkan konsep atau algoritma dalam pemecahan masalah. Kemudian untuk soal nomor 2, indikator yang sering muncul adalah indikator kemampuan menggunakan, memanfaatkan, dan memilih prosedur tertentu serta indikator untuk menerapkan konsep t atau algoritma dalam menyelesaikan masalah. Kemudian pada soal nomor 1 dan 2, indikator yang paling jarang muncul adalah indikator menyatakan kembali konsep.

Kata Kunci: Kemampuan Pemahaman Konsep, Bilangan Bulat, PMRI, LSLC

Abstract

This study is descriptive research that aims to investigate the students' ability in comprehending the mathematical concept of the powers of numbers of integer material using PMRI and LSLC approaches. The subject of this study is the 7th graders (VII.C) of SMP Srijaya Negara which numbered 30 students. There are four stages of LSLC in this study. First is design stage that is adjusted to the principles and characteristics of PMRI. The second is do (implementation) stage. The third is see (reflect) stage. The last is redesign stage. The learning process is adjusted to the principles and characteristics of PMRI and learning community. The data collection technique used in this study is written test consisting of 2 essay test items, observation and interview needed to obtain the supporting data. Based on the results of the study, it is found that the overview of the students' ability in comprehending the mathematical concept of the powers of numbers of integer using PMRI and LSLC approaches with the following details: in question number 1, the indicator that often appears is the indicator that that apply concept or algorithms in problem solving. Then, for the question number 2, the indicators that often appear are the indicator of the ability to use, utilize, and choose certain procedures and indicator to apply concept t or algorithms in solving problem. Then, in question number 1 and 2, the indicator that most rarely appear is indicator of restating the concept.

Keywords: Concept Comprehension Ability, Numbers of Integer, PMRI, LSLC

How to Cite: Farida, L., & Renaldo, M. (2021). Understanding the mathematical concepts of students with exponential number through PMRI and LSLC. *Sriwijaya International Journal of Lesson Study, 2*(1), 11-22.

INTRODUCTION

Numbers is a branch of mathemathics that has an important role in mathemathics learning. It is because numbers are included in the cirriculum and introduced since children have in the formal education yet (Novita & Putra, 2017).

One of the sub-chapters of numbers material is exponents. In solving exponential problems, an understanding of students' mathemathical concept about expontential numbers is needed. After

understanding, students are able to explain the relationship between concepts, apply concepts, and solve the problems (Sunnardi, 2017). understanding mathematical concepts has a positive effect on problem solving. The higher students' ability to understand mathematical concepts, they are more likely to understand, solve, and interpret the solution of a problem (Hartati, et al., 2017). students are expected to rediscover mathematical concepts with contextual problems. This shows that students' ability to understand concepts is needed (Fadlilah, 2014).

However, Tauzahrah (2016) stated that students still have difficulty to understanding the concept of exponential numbers, specifically students are unable to remember the necessary conditions of the character of the exponential number operation which is the multiplication operation. In this case, students only remember if the bases of the exponents are equal, the exponents are added, but most students forget that the operation used is the multiplication operation. Therefore, it is necessary to understand students' mathematical concepts, so that students have no difficulties for the next material.

The learning process of educational units is organize in an interactive, fun, inspirational, challenging, and motivating way to participate actively (Kemendikbud, 2016). As for the learning in the 2013 curriculum, students are directed to discover their own concepts, facts, and values in everyday life. This means that learning is not teacher-centered, but students are required to be active in the learning process.

But in fact, according to Ulfiana, et al. (2016) learning is only centered on teachers and teachers do not provide opportunities for students to exchange opinions between students. When they are given problems, students experience difficulties and less able to use their understanding of the concepts. Meanwhile, according to Hamidah (2013) the teacher teaches directly to provide examples of the numbers which results in students not being good at understanding concepts, students sometimes just memorize them, so that when students are given new more complex problems, students cannot solve them. Because of this, the teacher has an important role in designing learning, so that students easier to understand the concepts of exponents. Therefore, a suitable model, approach, or learning method is needed in the learning process.

One of the appropriate approaches to support the 2013 curriculum is use an approach to learning mathematics in the education field, in Indonesia known as Pendidikan Matematika Realistik Indonesia (PMRI)approach, where mathematics must be close to student life and real situations (Putri, 2013). The PMRI approach is an approach to learning mathematics that provides opportunities for students to be active in the process of building their own knowledge (Zaini & Marsigit, 2014).

According to (Zulkardi, 2002; Utari, et al., 2015) PMRI is a human and mathematical activity that must be linked significantly to the context that exists in students' daily lives. (Pujiati, 2017) states that learning mathematics must start with problems related to everyday life, by using this context students will gradually be guided to master mathematical concepts.

However, in the implementation of learning using the PMRI approach, teachers still experience some difficulties in implementing it. This is in line with Yuliana's (2015) opinion that in implementing the PMRI approach, there are still difficulties in creating a comfortable and conducive classroom atmosphere. Afterwards, according to Sari & Nurhidayah (2014), the implementation of PMRI learning took a lot of time for discussion and many students asked for teacher assistance, at the time of the implementation of PMRI learning is still not optimal because there are still some students who are less active and depend the answer to their friend. Tandililing (2012) also said that in

the implementation of PMRI learning, the discussion are still controlled by the smart group, while for groups that are less likely to be passive.

Therefore a system is needed to support learning using the PMRI approach which still has several weaknesses in the implementation, one of them is by implementing a lesson study for learning community (LSLC). This is in line with the opinion of Widjajanti & Listyani (2013). The aim of the PMRI approach is to make learning mathematics meaningful for students. Therefore, what must be done is to change the mathematics teacher's perspective in the learning process which is only teacher-centered. Changing the teacher's perspective is certainly not easy. Lesson study can be used as the right forum to change the teacher's perspective is because the teachers together get to know students, the material, and the concrete learning process of the problems that occur in the classroom.

Afterwards, Sunnardi, et al., (2017) revealed that it is necessary to align the 4C indicators with the 2013 curriculum in Mathematics. Based on the Directorate General of Primary and Secondary Education (2017) education in Indonesia has a unique character in accordance with Indonesian culture, based on the Directorate General of Primary and Secondary Education (2017) education in Indonesia has a unique character in accordance with Indonesian culture, it is in line with the demands of the 21st century. One of them is collaboration (Collaboration). in more effective collaborative learning, it needs to be applied with lesson study. Its also raised by Santia (2016) that lesson study is an activity that encourages the formation of a learning community. where in the learning community (learning community) will create collaboration between students.

Learning with Lesson study is good to implemented in a lesson, because it has the same goals as educational goals (Murtisal, et al., 2016). according to Sato (2014: 16) in lesson study learning, teachers must strive to discuss and design the best learning process for students, so that students can understand basic knowledge, and how to use the basic knowledge obtained so that students truly master the concept and knowledge.

Therefore, researchers are interested in conducting research by applying the PMRI approach and lesson study for learning community (LSLC) to determine the ability of students to understand mathematical concepts on integer numbers.

METHODS

This type of research is a descriptive study with research subjects of 30 students VII C class of SMP Srijaya Negara Palembang. The data collection techniques are use observation, a written test consisting of 2 description questions, and interviews. in this study using descriptive data analysis. This research is carried out in accordance with the LSLC stages, namely Plan, Do, See, and Re-design.

Plan

The researcher and the mathematics subject teacher carried out the activity of compiling the RPP (lesson plan) according to the principles and characteristics of PMRI, making LKPD I (share task), LKPD II (jumping task) adjusted to the characteristics of the PMRI and written test questions adjusted to the indicators of students' ability to understand mathematical concepts. Afterwards, formed 8 groups consisting of 4 people (2 girls and 2 boys, if possible) and heterogeneous group division consisting of smart, moderate, and less student, which confirmed directly by the mathematics

subject teacher in class VII C, validated the expert on the learning device and determined the model teacher.

Do

Researchers and other teams act as observers while teachers carry out mathematics learning activities according to the lesson plans that have been made by applying the PMRI approach and the learning community. With the following stages: (1) The teacher performs apperception using the context of cutting the paper which divided into two, and cut again to the third cutting (sitting position letter U)(2) Students form a learning community, one group consist of 4 people (2 boys and 2 girls, if possible) (3) Students do a share task, if they experience problems, students must have to ask their friends(4) Students who able should teach friends who ask for help (5) Students do jumping tasks, with the same rules when working on share tasks. (6) Students work independently.

See

This stage aims to find the advantages and disadvantages of implementing learning. Where the teacher and the observers jointly reflect on the learning that has been done. Reflections carried out are the results of the observer's findings on student activities. Starts withconveying the feeling of the model teacher about the learning that has been done. Then the observers delivered the results of observations that had been observed regarding the students who were their focus.

Re-design

This stage is carried out after the implementation of the see stage which is intended to improve learning tools in accordance with the suggestions and input from the observers during reflection.

RESULTS AND DISCUSSION

In the plan stage, researchers and teachers of class VII mathematics at SMP Srijaya Negara Palembang jointly designed learning tools in the form of lesson plans, LKPD I (share task), LKPD II (jumping task), and test questions. In making the lesson plan, it is adjusted to the characteristics and principles of PMRI. LKPD I (share task) contains routine questions at book level, and LKPD II (jumping task) contains non-routine questions adjusted to PMRI characteristics.Afterwars, the test questions are adjusted to the indicators of students' mathematical concept understanding ability which consists of 2 description questions. In addition, the researcher along with the seventh grade mathematics teacher determined the model teacher.

In the do stage, the model teacher implements the learning process in accordance with the learning plan that has been made with the researcher and the mathematics subject teacher in grade VII. In the preliminary activity the teacher says greetings and checks the attendance of students, then conveys the learning objectives and makes apperception (doing paper clippings which are divided into two equal parts, and dividing them again until the 3rd cut as an illustration for students in doing share task activities, at the time of perception the sitting position of the students forms the letter "U". Then the teacher distributes LKPD I (share task) to each student. In LKPD I (share task) is given problems using the context of cutting paper.In this activity students can use paper props and change them into a mathematics model,and in this activity can be collaborative (collaboration) between students.After

the operation of LKPD I (share task) is finish, the teacher asks one of the students to present the answer in front of the class.

Furthermore, the teacher distributed LKPD II (jumping task) which contained problems using the context of amoebic cell division. Students are asked to describe the division process and turn it into a mathematical model, students who experience problems must ask their group of friends and their friends must teach until they can. After the students finished working on LKPD II (jumping task), the teacher asked one of the students to present their answeragain. At the end of the lesson the teacher distributes test questions and closes the lesson by asking one of the students to conclude the learning that has been implemented..

After carrying out the test of students' ability to understand mathematical concepts, the following results were obtained.

Table 1. Frequency of students who meet the ability to understand mathematical concepts

Indicator	Restating Concept	Apply Conceptor Algorithm Stosolve Problems	Using Proper Proceures
Question 1: The number of student who meet	10 Students	18 Students	13 Students
Question 2: The number of student who meet	-	20 Students	20 Students

Question Number 1

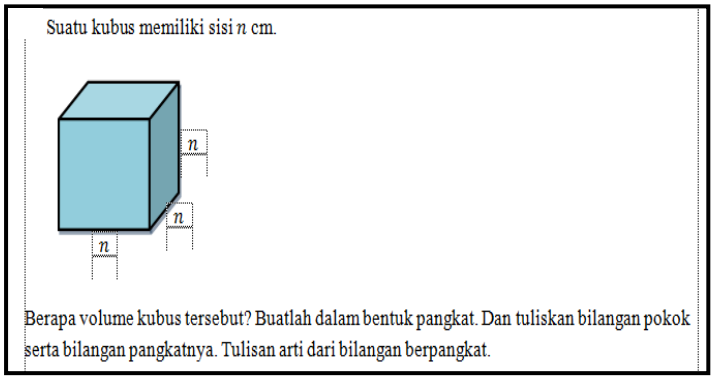
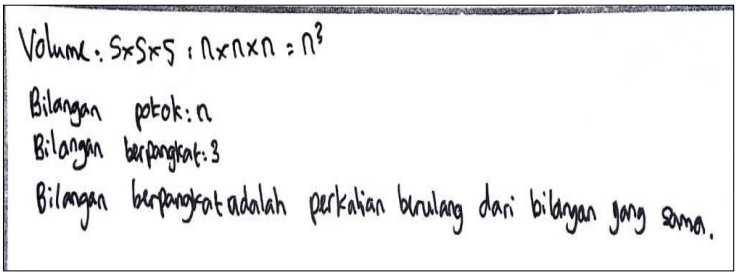


Figure 1. Question test number 1

At the question number 1 there are 3 kind of student answer.

a. Student answer true and complete

There is the answer of student FJ who is one of the student who answer correctly and completely in the question number 1.



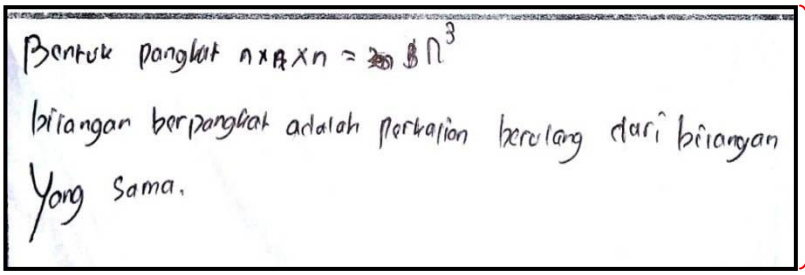
a. Students able to apply the concepts to resolve the problems
b. Students able to answer truly and use the right proceurs
c. Students already able to restate concepts correctly and completely

Figure 2. Students' answer (FJ)

Student answers FJ, student able to restate the concept, where student able to define the meaning of exponents. Then the student able to write down the procedures correctly and completely, which means the student had come up with indicators of using the right procedures. And student have been able to apply repeated multiplication to form exponential numbers, which means that student have raised indicators of applying concepts or algorithms in solving a problem. Based on the observations of student FJ, student active in learning, and able to conclude at the end of the learning process. This is supported by the results of interviews with FJ. From the results of the interview, student have come up with indicators that restate the concept correctly and completely, so that student get a score of 15.

b. Students answered correctly and incompletely

There is the answeq of student IL who is one of the student who answer correctly and incompletely in the question number 1.



a. Students able to apply the concepts to resolve the problems even though not maximal yet
b. Students able to use the right proceursbut not maximal yet
c. Students already able to restate concepts but not maximal yet

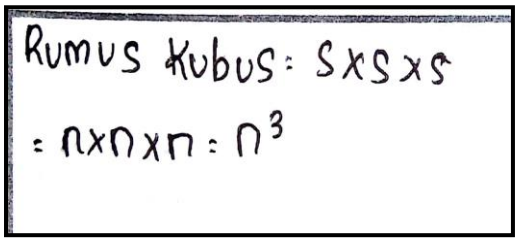
Figure 3. Students' answer (II)

The results of student answers, student have been able to bring up indicators of ability to restate concepts but not maximally, where student have been able to define the meaning of exponents, but student have not answered all the questions presented by the questions. Then the student able to use the procedure but it was still incomplete, where the student did not first write down the formula for the volume of the cube. Which means that student are able to use, utilize, and choose procedures appropriately but not maximally. Student have been able to apply concepts and algorithms in solving problems, this can be seen from the students' answers multiplying $n \times n \times n$ and converting it into exponent form. According to the observer, when working on the LKPD I (share task) student looked confused in working on the questions. But IL always asks for help to teach his friends who understand better. And when taught IL immediately worked on the questions. In the answer in LKPD II (jumping task) student IL have done the questions correctly, but IL has not written the steps for the process and has not written the conclusion. This is supported by interviews of researchers with

IL who represent answer number 1 which is correct and incomplete. From the results of the interview, IL were able to restate the concept correctly and completely, but the student were not careful in reading the questions. So that the researcher gave a score of 4. Then the student were able to use the procedure appropriately, but not maximally so that the researcher gave a score of 4. Afterwars, students have applied concepts and algorithms in solving problems, so the researcher gives a score of 5. Specifically, students with correct and incomplete answers get a total score of 13.

c. Students answered correctly and incompletely

The following are the answers of student (HS) which represent the correct and incomplete answers of the students.



a. Students are able to apply concepts to solve problems
b. Students do not come up with indicators restating concepts
c. Students are able to answer correctly using proper procedures

Figure 4. Students' answer (HS)

The results of students' answers have not been able to bring up the ability to restate the concept, because student do not answer questions about the definition of exponents. However, student have been able to come up with indicators using the right procedure, this can be seen from the answers of student who write down the volume of the cube first, HS enter the side of the cube and make it a power. And student are able to apply the concept of repeated multiplication to solve problems. Thus student have been able to come up with indicators of applying the concept or algorithm in problem solving. This is supported by the results of interviews with HS who represent correct and incomplete answers. From the test results the student did not write down the meaning of exponential numbers and based on the results of the interview it turned out that the student forgot what exponential numbers meant. Thus the student did not raise the indicators of the ability to restate the concept. Then student have been able to come up with indicators of using, utilizing, and choosing the right procedure even though it is not optimal. This can be seen from the process of student multiplying n × n x n, but in the results of the interview the student could not explain where n × n × n was obtained, the student only understood that there were three n so n points 3 So that the researcher gave a score of 4. Next, student have been able to come up with indicators of the ability to apply concepts or algorithms in solving problems. This can be seen from the results of students' answers who are able to apply the concept of repeated multiplication to solve problems. And based on the results of the interview students were able to explain correctly. So that the researchers gave a score of 5. The total score obtained by student was 9.

Question Number 2

3. Berikut adalah jarak antara matahari dengan planet-planet dalam tatasurya.

Planet	Jarak
Bumi	$14{,}96 \times 10^7$
Jupiter	$7{,}783 \times 10^8$
Merkurius	579×10^5
Mars	2279×10^5
Venus	10820×10^4

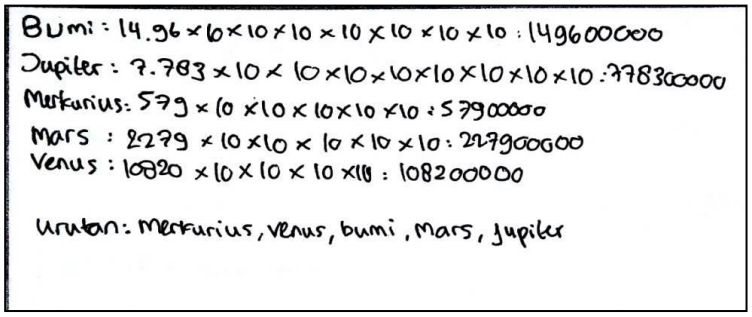
Urutkanlah Sistem tatasurya berikut dari yang paling dekat dengan matahari!

Figure 5. Question test number 2

In the question number 2 there is 2 kind of students answer.

a. Student answers with truly an completely

Following are the answers of PT students in number 2 who answered correctly and completely.



Bumi : 14.96 × 10 × 10 × 10 × 10 × 10 × 10 × 10 : 149600000
Jupiter : 7.783 × 10 × 10 × 10 × 10 × 10 × 10 × 10 × 10 : 778300000
Merkurius : 579 × 10 × 10 × 10 × 10 × 10 : 57900000
Mars : 2279 × 10 × 10 × 10 × 10 × 10 : 227900000
Venus : 10820 × 10 × 10 × 10 × 10 : 1082000000

Urutan : Merkurius, Venus, bumi, Mars, Jupiter

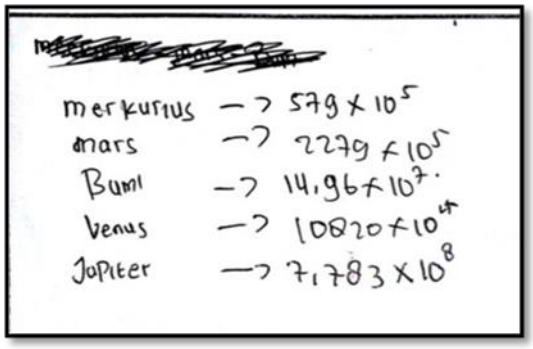
a. Students are able to apply concepts to solve problems
b. Students are able to use procedures correctly and correctly

Figure 6. Students' answer (PT)

The answers of student PT, student have been able to write procedures correctly and completely can be seen from the way student change exponents to repeated multiplication, which means that studenthave come up with indicators of using, utilizing, and choosing the right procedure. And student have been able to apply the concept of repeated multiplication to solve problems of everyday life. Based on the observations of student, during the share task process student help their friends who ask for help, not only during the process of working on the share task, but when student teach their friends when presenting their answers in front of the class. This is supported by the results of interviews with students of PT. From the results of the interview,students had shown indicators that students were able to use procedures correctly and completely, so the researcher gave a score of 5. Then students are also able to apply the concept of rank numbers to solve a problem, so that students get a score of 5.With a total score of 10.

b. Students answered incorrectly and incompletely

GM students who answered incorrectly and incompletely in question number 1.



a. Students have not applied concepts to solve problems
b. Students answered incorrectly and did not use proper procedures.

Figure 6. Students' answer (GM)

The results of the students' answers, student have not used the procedure correctly and appropriately, student immediately put in order without looking at their rank. Thus, student have not been able to use, utilize, and choose procedures appropriately. Then, student also have not been able to apply concepts and algorithms in solving problems, this can be seen from the students' answers that do not change the form of power to repeated multiplication. Based on the results of observations during the process of sharing tasks and jumping tasks, student were just silent and did not ask for help from their group friends. This is supported by interviews of researchers with GM student who represent answer number 2 which is incorrect and incomplete. From the results of interviews with GM, student were not able to use the procedure appropriately because student were not careful in reading the questions. So that the researcher gave a score of 2. And student were also not able to apply concepts and algorithms in solving problems, so the researcher gave a score of 2. Specifically, student with correct and incomplete answers got a total score of 4.

The implementation of learning uses PMRI and LSLC, students are still familiar with the method commonly used by teachers, namely the lecture method, students are used to only listening to explanations from the teacher. This is in line with the opinion of Ulfiana, et al. (2016) that the learning process that is usually carried out is only centered on teachers and teachers do not provide opportunities for students to exchange opinions between students. So that when the learning community and PMRI were implemented there were several obstacles including: students seemed less active in learning, and were not used to asking for help from their friends, and students who were smart still seemed unwilling to teach their friends who asked for help, because students were still used to competition inside class.This is supported by observations from observers when working on share tasks and jumping tasks, students experience several obstacles including the lack of tools for cutting paper, students are reluctant to cooperate with their group of friends, and students are still accustomed to copying other students' answers and are not used to ask to please teach his friend. At the time of working on the test questions, there were still students who did not answer all the questions in the questions, students were not used to working on questions with interrelated information so that many questions that should be answered were missed, which in the end the students were unable to define the expected concept. In line with Zulkardi, et al. (2014) students with low abilities in reading questions and interpreting the meaning of the questions into mathematics still need a long time to understand the questions. And there are students who answer questions without using the concepts they have chosen, they only use estimates to sort numbers with powers. This is

supported by the opinion of Kesumawati (2008) that understanding of concepts cannot be given coercion and when students forget the concept or algorithm, the student cannot solve math problems.

From the research, it can be concluded that after the implementation of learning using PMRI and LSLC, students' ability to understand mathematical concepts has reached the ability to restate concepts, the ability to use appropriate procedures, and the ability to apply concepts or algorithms to solve problems. Thus, learning using the PMRI and LSLC approaches can be applied in schools, it is just that it requires habituation for teachers and students in learning using PMRI and LSLC.

CONCLUSION

Based on the results of research in VII C class SMP Srijaya Negara Palembang,on the ability of students to understand mathematical concepts using PMRI and LSLC on integer material was found that the students' ability to understand mathematical concepts had arrived at restating concepts, applying concepts or algorithms to solve problems and using, proper procedure.

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