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Supporting Student's Ability in Understanding Least Common Multiple (LCM) Concept Using Storytelling

Septi Triyani, Ratu Ilma Indra Putri, Darmawijoyo

Abstract

Several researches showed that students had difficulty in understanding the concept of Least Common Multiple (LCM) in Elementary School. This underlies the researcher to design a learning of LCM using storytelling, *Legend Putri Dayang Merindu* (LPDM), which contains situational problem related to LCM. The purposes of this study are to know the role of LPDM in supporting students' ability to understand LCM concept and to generate a student learning trajectory in learning of LCM using LPDM. This research uses methodology of design research consists of three steps (i.e. preliminary design, teaching experiment and retrospective analysis), and the learning approach of realistic mathematic education, labeled by PMRI in Indonesia. From the research result conducted in MIN 1 Palembang can be concluded that the learning of LCM using LPDM has role in supporting students' ability to understand LCM concept. Therefore, student learning trajectory to understanding LCM concept is started from solving of situational problems based on LPDM until formal solution of LCM. In this case, there are three stages that students through (i.e. understanding concept of multiple, common multiple and LCM) using various strategies in the level situational, model of, model for and formal.

Keyword: *Least Common Multiple (LCM), Design Research, PMRI, Storytelling, Legenda Putri Dayang Merindu.*

Abstrak

Beberapa penelitian menunjukkan bahwa siswa mengalami kesulitan dalam memahami konsep Kelipatan Persekutuan Terkecil (KPK) di Sekolah Dasar (SD). Hal ini yang mendasari peneliti mendesain pembelajaran KPK menggunakan cerita, *Legenda Putri Dayang Merindu* (LPDM), yang didalamnya terdapat permasalahan situasional terkait KPK. Untuk itu, Tujuan dari penelitian ini adalah untuk mengetahui peranan LPDM dalam mendukung kemampuan siswa untuk memahami konsep KPK melalui strategi yang mereka gunakan; dan menghasilkan lintasan belajar pada pembelajaran KPK menggunakan LPDM. Pada penelitian ini digunakan metodologi desain riset yang terdiri dari tiga tahapan (yaitu *preliminary design, teaching experiment* dan *retrospective analysis*, dan pendekatan pembelajaran Pendidikan Matematika Indonesia (PMRI). Dari hasil penelitian yang telah dilaksanakan di MIN 1 Palembang, dapat disimpulkan bahwa pembelajaran KPK dengan menggunakan LPDM memiliki peranan dalam mendukung kemampuan siswa untuk memahami konsep KPK. Selanjutnya, lintasan belajar siswa untuk pemahaman konsep KPK berawal dari penyelesaian permasalahan situasional pada LPDM hingga

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penyelesaian formal KPK. Dalam hal ini terdapat tiga tahapan yang dilalui siswa (yaitu pemahaman konsep kelipatan, kelipatan persekutuan, dan KPK) dengan beragam strategi baik pada tahap situasional, *model of, model for* dan formal.

Kata Kunci: *Kelipatan Persekutuan Terkecil (KPK), Desain Riset, PMRI, Cerita, Legenda Putri Dayang Merindu*

Introduction

Student's difficulty in understanding the concept of Least Common Multiple (LCM) and in solving problems related to that concept are showed by some researches that its difficulty as the implication of teaching learning of LCM taught in the formal level directly using procedural and manipulative ways (Orhun, 2002; Dias, 2005; and Camli&Bintas, 2009). Hence, efforts to support student's ability in understanding of LCM concept are needed in order the successful study of student. This can be done through learning activity based on student's previous knowledge and experience. Mentioned in Gravemeijer (1994), mathematics is not only material transferred by teacher to students. In this case, student should be given chance and be guided into situation to reinvent mathematics concepts using their own way. One of mathematics learning methods oriented in mathematizing of daily experience is Realistic Mathematics Education (RME), which in Indonesia it is known as *Pendidikan Matematika Realistik Indonesia* (PMRI). RME ideas came from Fruedental which emphasizes mathematic as human activity (Heuvel-Panhuizen, 1996). Human activity related to the real life which the term of "real" is not only mean as fact can be seen, but also as situations that is experientially real or gives meaning for students.

These issues underlie this research in designing of instructional activities for LCM concept. Using methodology of design research and PMRI approach, the researcher involves Indonesian storytelling, the legend of Putri Dayang Merindu. This research is conducted in grade forth elementary school (MIN 1 Palembang, Indonesia), which according to Indonesian curriculum, in that grade student start to learn LCM and it is continued in the grade fifth and sixth elementary school. In teaching learning of LCM using storytelling, the story used in this study is a story containing mathematics aspect besides moral value to grow positive characters of students. Therefore, *Legenda Putri Dayang Merindu* which contain contextual problem related to LCM was used in this study as starting point in learning and those problem was developed according to

students' learning trajectory in understanding LCM concept. Using storytelling in mathematics learning is also based of many research showed that it can give positive effects in meaningful mathematics learning and for enjoyment, besides it can improve students' understanding about the mathematics concept that students learn (Gradanidis, 2002; Goral, 2006; and Price, 2009).

Theoretical Framework

1. Least Common Multiple (LCM)

Mentioned in Sai (1992), *given any two non-zero whole numbers r and s, there is a smallest or least multiple that they have in common; this multiple is called the LCM.* By a multiple of a number is meant the number obtained by repeated addition. For example, 15 is a multiple of 3 because repeated addition of 3 up to five times gives the number. Carter (2001) defined LCM as a *smallest number that can be divided by two or more numbers with no remainder.* There are three main approaches that usually are used in finding LCM between two numbers (Brown, Thomas and Tolias, 2002), namely:

(1) *Set intersection*: creating an ordered list of consecutive multiples for each number and finding the first one that appears in both lists

(2) *Creating a multiple and divide*: creating an ordered list of consecutive multiples of one number and simultaneously checking each new entry for divisibility by the second number;

(3) *Prime-factorization*: comparing the prime factorization of the two numbers and finding the minimal product of prime powers that contains both of their factorizations (often referred to as "the higher exponent" rule).

Brown (2002) remarks that the first two methods can be wieldy because it may require a large number of steps, but that, on the other hand, justifying these two first methods is much more intuitively done than explaining why the "higher exponent" rule works.

2. Indonesian Version of Realistic Mathematics Education (PMRI)

The concept of mathematics is abstract and this makes students get difficulty in mathematics learning. Consequently, students' lack experience and comprehension of mathematics in daily life. PMRI as one of mathematic approaches support students to

become more active learners and thinkers as mathematics is seen as human activity. In PMRI, by the help of teacher, during teaching and learning process, students are facilitated to explore their ideas and strategies and guided to find mathematics concepts and get more understanding about the mathematics concept they learn. There are five tenets for Realistic Mathematic Education as mentioned in Gravemeijer (1994), namely:

(1) *Phenomenological exploration or the use of context*

The instructional activities are started from informal or situation that is experientially real for students to learn the basis of formal concept.

(2) *Using models and symbols for progressive mathematization*

It uses models and symbols as transition from a concrete context to formal knowledge

(3) *Using student's own contribution*

Contributions in learning process are hoped come from student own production construction which orient them from informal solution to more formal.

(4) *Interactivity*

Learning process of students is not a solo activity, but it occurs in asocial context

(5) *Intertwinement*

An integrating a variety of mathematics topic and other relevant learning theories

3. Using Storytelling in mathematics learning

Using story in mathematics learning can make mathematics becomes more of a set of interesting and connected personal stories to be shared and discussed, rather than a set of procedures to be memorized and applied (Gradanidis, 2002). As mentioned in Goral (2006) storytelling can be used to introduce difficult mathematics and it appeals to children's imaginations and emotions and helps make learning more meaningful. There is evidence that children have more success learning and understanding material when it is presented in a way that is meaningful to them. Using story gives opportunities for students to become engaged in a mathematics concept being taught, thereby creating a meaningful context for the student (Price, 2009). There are valid ways to communicate stories to children, reading stories and storytelling. However, Raines and Isbell (1994) in Goral (2006) note that storytelling is more personal as the storyteller can match the story to the audience, use constant eye contact, and make

adjustments and clarifications when necessary to enhance understanding, whereas when reading from a book, the reader is focused on the text and written word, and can only periodically make eye-contact with the listener. The story used in this study, namely *Legenda Putri Dayang Merindu* is adapted from the book written by Yass (1993) and Poerwanto (2002).

Result and Analysis

In this study, there were 6 students' activities in the class, which each activity is to reach the goal of understanding LCM concept, namely: Activity 1-3 for understanding multiple concept; Activity 4 for understanding common concept; Activity 5 for understanding LCM; and activity 6 for implementing LCM concept to solve daily problem related to LCM. All of these activities were implemented during teaching experiment. Therefore, the result of teaching experiment is used to answer two research questions of this study; *first*, how is the role of *Legenda Putri Dayang Merindu* in supporting students' ability for understanding LCM concept? *Second*, how is student's learning trajectory in learning of LCM using *Legenda Putri Dayang Merindu*?

Storytelling Roles in Supporting Student's Ability for Understanding of LCM concept

1. *Students' motivation in mathematics learning and moral value learning of the story*
   How could the story motivate students in mathematics learning in the class were shown from the students' engagement during the learning process, the student's readiness to solve the given problems and the students' ability to involve parts of the story when they solve the problems. This was as shown from students' enthusiasm when the teacher told the story of *Legenda Putri Dayang Merindu* in the class. Students' motivation in mathematics learning influences the students' readiness and engagement during learning process. In the next activities, points of the story also influence students' motivation in solving the problems, so that the students consider the solution for the given problems as the solutions for the contextual problem in the story. Therefore, some of the moral values that were learned from the story is the obedience of children to their parents as shown from the obedience of Putri Dayang Merindu toward her parents; How someone should

return losing something of someone else as be shown from the kindness of Kemala Negara to return Putri's lost something. Hence, this also can be one of ways to support students' positive character building as a part of education purpose.

2. *Starting point in mathematics learning*
   a. In *Legenda Putri Dayang Merindu*, there are contextual problems related to LCM that can facilitate the student's beginning knowledge and experience to solve those problems. The contextual problems from the story are how many times Putri took a bath in the river for one day, two day, etc., if she took a bath every twice a day; and when did the Putri go to the place where she meet with Kemala, which both of them made appointment to meet every two days. The students' solution in solving these problems is using their understanding about day, date, how many days again, addition and multiplication. Using of this students' beginning understanding from their own experience and knowledge indicates that the role of the legend as starting point in the learning process is very important as an indicator of students' experience and ability to solve the problems related to LCM.
   b. In *Legenda Putri Dayang Merindu*, there are contextual problems related to LCM that can stimulate students thought so that the students' reasoning towards LCM concept can be emerged. This can be shown from the student's ability to identify regular activities based on the legend which stimulates students' thought in understanding problems related to LCM. Using the developed problems to the students, two points of contextual problems based on the legend can support the students' reasoning towards LCM concepts. This can be described from the result of students' learning process in the some activities.
      - In the first activity, from the students' reasoning and strategies in determining how many times Putri take a bath in the river during one day, two days, three days, etc. can support students' reasoning to understand multiple concept using addition or multiplication.
      - In the first and second activity, from the students' reasoning in determining day, date, and how many time Putri will go again can support students' reasoning to understand multiple concept.

- In the forth activity, from the students' reasoning in determining day, date, and how many time Putri and Kemala would meet again, if they made appointment to meet every two days, can support students' reasoning in understanding common multiple concept.

- In the fifth activity, from the students' reasoning in determining day, date, and how many time again Putri and Kemala would meet again for the nearest meeting from the first meting, if they made appointment to meet every two days, can support students' reasoning in understanding LCM concept.

3. *Providing visible problem that can be solved using students' own strategies*

This is shown from students' ability in solving contextual problems based on *Legenda Putri Dayang Merindu* as problems given in the 1-5 activities.

- The problem given in the first and second activities are determining how many times Putri took a bath in the river for one day, two day, etc. if she took a bath every twice a day; and when does the Putri went to the place where she meet with Kemala, which both of them made appointment to meet every two days. In this case, student could solve the problems using their acquired knowledge, namely day, date, how many times again, addition, and multiplication.

- The problem given in the forth activity are when would Putri and Kemala meet again if they made appointment to meet every two days. In this case, student could solve the problems using their acquired knowledge, namely day, date, how many times again, addition, multiplication, and multiple.

- The problem given in the fifth activity was when would Putri and Kemala meet again for the nearest meeting from the first meting, if they made appointment to meet every two days. In this case, student could solve the problems using their acquired knowledge, namely: day, date, how many times again, addition, multiplication, and common multiple.

4. *Emerging students' strategies*

- In the second activity, students can find multiple concept by explaining the meaning of multiple (Image 1)

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Image 1. Student's explanation about the meaning of multiple

Image 1 shows that student explains multiple of a number as the number that is calculated by repeated addition using the same number or by multiplication using number 1, 2, 3, etc.

- In the third activity, students can find multiple concept by determining multiple using various strategies (Image 2).
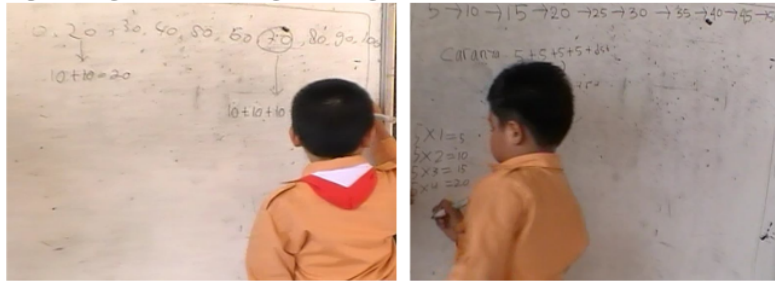

Image 2. Students' strategies to determine multiple of a number

Image 2 shows that the strategies used by the students to determine multiple of a number is using repeated addition and multiplication with natural number.

- In the forth activity, students can find common multiple concept by explaining the meaning of common multiple and determining common multiple using various strategies (Image 3).

Image 3. Student's explanation about the meaning of common multiple and student's strategy to determine common multiple of two numbers

Image 3 shows that student explained common multiple as the same multiple or the same number that is found by determining multiple. It also shows the student's strategies in determining common multiple by making list of multiple.

- In the fifth activity, students can find common multiple concept by explaining the meaning of LCM and determining LCM using various strategies.
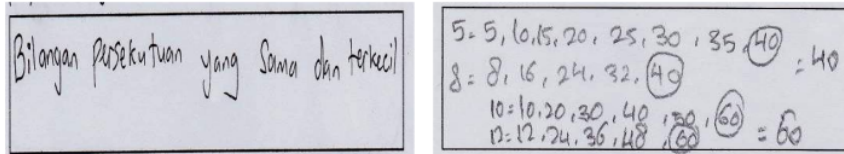

Image 4. Student's explanation about the meaning of LCM and student's strategy to determine LCM of two numbers

Image 4 shows that student explained LCM as the same and smallest number of common multiple. It also shows the student's strategies in determining common multiple by making list of multiple of each number by making circle sign for LCM.

5. *Supporting students ability in solving daily problems related to LCM*

This is as shown from the solutions given by the student for the problem given in the sixth activity. The problem in this activity was determining time which Ahmad and Ali would go to the Library for the nearest time from the first meeting, if they meet for the first time in September 15, 2011, which Ahmad goes to the library each three days and Ali each 5 days. In solving this problem, the students related the problem with the contextual problem based on *Legenda Putri Dayang Merindu*. In this case, the students make similarity between activity Ahmad and Ali go to the library and the activity of the meeting of Putri and Kemala. Students also make generalization in solving the problem to the other activities and different times of regular activities. By this ability, the given problem can be understood by the students and they can use their acquired understanding and strategies to solve the problem.

Students' Learning Trajectory from Informal to Formal

The description of students' learning trajectory from informal to formal in learning of LCM is focused on students' emerged modeling, which shows the development process of students' understanding from the informal level in solving of contextual problem based on *Legenda Putri Dayang Merindu* until understanding of LCM concept in the formal level. There are there stages that students get though to understand the concept of LCM during the learning process, namely: the stage for

understanding of multiple concept, the stage for understanding common multiple concept, and the stage for understanding of LCM. All of these stages will be described in paragraph below, and it's also will be described about student's ability in implementing LCM concept to solve daily problem related to LCM.

1. *Understanding of multiple concept*

This is shown from the students' learning process in the first, second and third activity which student get through levels of understanding from informal (situational) to formal in understanding multiple concept.

- In the first activity, students can identify regular activity based on the legend. In this case, there were students who just identified one regular activity in the legend, namely Putri took a bath in the river twice a day, and there were students who could identify all the regular activity in the legend, namely: took a bath in the river twice a day the regular meeting between Putri and Kemala each two days. In the class discussion, the teacher asked the students who just identify one regular activity to mention other activity that Putri did based on the legend. The student strategy in solving the problem related to Putri took a bath in the river are using addition, multiplication whether it is written using procedural mathematics concept or using mental calculation. Students also used the aid of fingers in calculation and the way how they wrote their solution is in the format that looks like table. Furthermore, the students' strategies in solving the problem related to the time which Putri will go again according to his appointment with Kemala are by using their understanding about day, date, how many times again, addition, and multiplication. The students' ability in using their understanding about day and date supports their ability to determine how many days again Putri will go, which helps students' reasoning in formal level of multiple concept. In this activity, students solved the problem in the level of situational and *model of* the given problem.

- In the second activity, using number cards that as the model to facilitate students in developing models from informal to formal, students could find unit table as *model for*. Using card help also help the student in clearer visualization of the given problem which student could imagine how to fill the number cards to determine the time when Putri went again. The emerged students' reasoning in

this activity also supports students' ability in understanding characteristics of multiple number which useful to understand the formal level of multiple concept.

- In the third activity, students have reached the formal level in determining multiple number though addition and multiplication. In this activity, there were various students' strategies which also show students' understanding level of multiple concept.

2. *Understanding of common multiple*

This is shown from the students' learning process in the forth activity. According to analysis of students' learning process in this activity, it shows that students have different level of understanding about common multiple which they emerge models from the situational level to the formal one. In this activity, students' acquired understanding about multiple help them in understanding the concept of common multiple. The term of "multiple" appeared from the students' reasoning in solving contextual problem about the meeting between Putri and Kemala based on *Legenda Putri Dayang Merindu*. In the legend, the meeting of Putri and Kemala which all of them went to the place where they made appointment each 2 days build students' understanding about common multiple of same numbers. Therefore, modification of the problem, which Putri and Kemala went to the place where they made appointment for each different day, builds students' understanding about common multiple of the different numbers.

The students acquired understanding about common multiple concept in the formal level from their ability in understanding contextual problems based on the legend, generalization of those problems and using their acquired knowledge about multiple concept. For the calculation, in this activity some students still used the aid of fingers. In this activity, the students used their understanding about day, and date which shows the situational level in solving the problem and they give their solution by developing *model of the* problem. Using number cards in this activity as in the second activity also facilitated the students to use unit table as *model for*. Students who reach the formal level use mathematics concepts to solve the problem, namely, addition, multiplication, and multiple. In this level, when the students made list of multiple of each number which would be found its common

multiple, they gave sign using circle for the same numbers of two multiple numbers in both of sides.

3. *Understanding of LCM*

This is shown from the students' learning process in the fifth activity. According to analysis of students' learning process in this activity, it shows that students have different level of understanding about LCM which they emerge models from the situational level to the formal one. In this activity, students' acquired understanding about common multiple help them in understanding the concept of LCM. The term of "multiple" appeared from the students' reasoning in solving contextual problem about the meeting between Putri and Kemala based on *Legenda Putri Dayang Merindu*. In the legend, the nearest meeting from the first meeting of Putri and Kemala which all of them went to the place where they made appointment each 2 days build students' understanding about LCM of same numbers. Therefore, modification of the problem, which Putri and Kemala went to the place where they made appointment for each different day, build students' understanding about LCM of the different numbers. The students acquired understanding about LCM concept in the formal level from their ability in understanding contextual problems based on the legend, generalization of those problems and using their acquired knowledge about common multiple concept. In this activity, most of students have reach the formal level in determining LCM by using mathematics concept, namely addition, multiplication, multiple and common multiple.

4. *Implementing of LCM concept to solve daily problem related to LCM*

This is shown from the students' learning process in the sixth activity. According to analysis of students' learning process in this activity, it shows that different level of students' understanding about the problem and their acquired mathematics concept influence the given solution and strategies of students. Most of students solve the problem using their understanding of mathematic concepts, namely multiple, common multiple and LCM. The students who can understand the situational problem rightly and relate their understanding about day and date, they could use their informal solution to solve the problem rightly. The other students

who can see the given situational problem as mathematics problem could solve the problem using informal and formal solution which shows that students develop *model of* and *model for* in solving the problem. Therefore, the students who could solve the problem rightly in the formal level are they who can use LCM concept properly and can implement the formal solution using that LCM concept to the informal solution of the problem.

Conclusion

The learning of Least Common Multiple (LCM) using *Legenda Putri Dayang Merindu* has role in supporting students' ability to understand LCM concept, namely: it can motivate students to engage the learning process and facilitate students to learn the moral values from the story; it can be starting point in learning because the story contains situational problem related to LCM in order to facilitate students' beginning knowledge and experience and to stimulate students' thinking that emerges reasoning toward LCM concept; it can make mathematical problem becomes visible for students and can be solved by their own strategies; it can emerge students' various strategies in reinventing LCM concept and in determining LCM through modification of situational problem based on the legend and the improvement of the problem through questions in students' work sheet; and it can support students' ability to solve daily life problems related to LCM. Therefore, students' learning trajectory to understanding LCM concept is started from solving of situational problems based on *Legenda Putri Dayang Merindu* until formal solution of LCM. In this case, there are three stages that students through (i.e. understanding concept of multiple, common multiple and LCM) using various strategies in the level situational, *model of, model for* and formal.

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