

SUPPORTING FIRST GRADE STUDENTS' UNDERSTANDING OF ADDITION UP TO 20 USING TRADITIONAL GAME

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Abstract

This research aim is to know the students' understanding in adding number up to 20 using traditional game of dakocan and to acquire learning trajectory of adding number up to 20 using traditional game of dakocan for the first grade of primary school. This research used methodology of design research that consists of three phases, there are preliminary design, teaching experiment, and retrospective analysis. Subject of this study is 33 first grade students of Sekolah Dasar Negeri (SDN) 98 Palembang as one of partners' school of Pendidikan Matematika Realistik Indonesia (PMRI). The result of this research shows that the students' understanding in adding number up to 20 can be stimulated by using traditional game of dakocan as a context. All of strategies and model that is used by students and also their result discussion shows how construction and contribution of students can help them to understand concept of adding number up to 20. All the activities that are done by students produce learning trajectory to gain the goal of learning. Each steps of learning trajectory of students has an important role in understanding the concept from informal to the formal level. Learning trajectory using dakocan that is produced consist of playing dakocan, put the model of dakocan to the frame ten dakomatika to understand the relation of part and whole of ten combination in adding number, and solving contextual problem in adding number up to 20.

Keywords: Adding Number, Dakocan, PMRI

Abstrak

Tujuan penelitian ini adalah mendeskripsikan pemahaman siswa terhadap konsep penjumlahan bilangan sampai 20 dan menghasilkan lintasan pembelajaran penjumlahan bilangan sampai 20 menggunakan dakocan, yang berkembang dari bentuk informal ke bentuk formal di kelas I SD. Metode yang digunakan dalam penelitian ini adalah design research dengan mendesain permainan tradisional dakocan untuk digunakan dalam pembelajaran penjumlahan bilangan sampai 20 melalui tiga tahap, yaitu preliminary design, teaching experiment, dan retrospective analysis. Subjek penelitian ini adalah 33 siswa kelas 1A SDN 98 Palembang yang merupakan salah satu sekolah mitra Pendidikan Matematika Realistik Indonesia (PMRI). Hasil dari penelitian ini menunjukkan bahwa pemahaman siswa mengenai konsep penjumlahan bilangan sampai 20 dapat dirangsang dengan menggunakan dakocan sebagai konteks dalam pembelajaran. Seluruh strategi dan model yang ditemukan atau digambarkan siswa serta hasil diskusi menunjukkan bagaimana konstruksi atau kontribusi siswa dapat digunakan untuk membantu pemahaman mereka. Aktivitas-aktivitas pembelajaran yang dilakukan siswa menghasilkan lintasan pembelajaran yang menuju tercapainya tujuan pembelajaran. Tahapan-tahapan dalam lintasan belajar siswa memiliki peranan penting dalam memahami konsep dari level informal ke formal. Lintasan pembelajaran penjumlahan bilangan sampai 20 menggunakan permainan tradisional dakocan yang dihasilkan meliputi bermain dakocan untuk menemukan konsep penjumlahan dan pengurangan bilangan, menempel model dakocan pada bingkai 10 untuk mengetahui hubungan bagian dan keseluruhan yaitu sepuluh pada penjumlahan bilangan, dan menyelesaikan masalah kontekstual dalam penjumlahan bilangan sampai 20.

Kata kunci: Penjumlahan Bilangan, Dakocan, PMRI

One of aspect in Mathematics based on *Kurikulum Tingkat Satuan Pendidikan (KTSP)* at level of primary school is number. This is consistent with the emphasis by the NCTM (2000) that learning number in elementary level is important for learning other subjects. Therefore, learning number is one of prerequisite knowledge for learning mathematics on other topics. One aspect of the material belonging to the number is adding number up to 20 in the first grade of primary school taught in odd semester.

The fact found in the field at the time of observation in PMRI partner school in Palembang is the students do not understand the concept of adding number. The problem is in line with research Torbeyns, Verschaffel, and Ghesquiere (2004), which states that there are differences in the understanding of the concepts of addition, on the characteristics and development strategies among students with high math achievement with low student achievement. Furthermore, according to the study of Meliasari (2008) and Putra (2011), first grade primary school students in Indonesia are not able to provide arguments how to use addition algorithm and does not have any understanding of the relationships between numbers.

Based on the results of these studies, the problems of students encountered in learning addition are caused by the teacher still use instructional method directly on the formal mathematics level. Meanwhile, according to Gravemeijer (1994) that mathematics is not just a matter that is transferred by the teacher to the student, but actively engages students to reinvent the mathematical concepts in their own way. Learning mathematics that appropriate and oriented to mathematization of everyday experience is PMRI.

Several studies about PMRI involving traditional games give results that the use of traditional games as a context for learning give a positive influence on learning mathematics that more meaningful, fun, and it can increase students' understanding of mathematical concepts learned (Jaelani, 2012; Charitas, 2012). In line with this, Zulkardi and Ratu Ilma (2006) state that context is the first step in learning mathematics. This is confirmed also by Somakim (2008), that by integrating game into the learning process, helped students learn while playing so that students become active and fun to learn. Traditional game is a context for learning. One of the traditional games that can be used as a context for learning adding number up to 20 is *Dakocan*.

Based on the color, shape, and the rules of the game that produces winners and losers, as well as the songs and movement art, *dakocan* traditional game can be an attractive alternative that can be used as a starting point to teach concepts of adding number up to 20 in the first grade primary school students that is integrated with other subjects in the thematic learning. This study aims to describe students' understanding of the concept of adding numbers up to 20 using *dakocan* and produce student learning trajectories evolved from the informal to the formal level.

Counting is the most natural way to determine the number of the set of objects. Count one by one is a basic strategy for students to solve addition problems. Freudenthal (1991) believes that counting is the first mathematical verbal form of child. Furthermore, Gelman and Gallistel (1978)

states that there are three principles that children need to count which are (1) one-to-one that requires children to learn to count objects only once, or if not they will get the wrong amount; (2) the constant sequence; and (3) find the sum total of a set of objects is calculated and the result is the number of the last. Beside that, there are three main stages in the development of counting as an addition strategy, namely: (1) counting all; (2) counting on from first; and (3) counting on from larger (Butterworth, 2005).

Strategies such as counting-on, and a deeper understanding of such relationships, and a whole section is an important part of learning (Fosnot & Dolk, 2001). Without an understanding of the strategy, students will count all the items when they solve the problem of addition. Deeper understanding of the relationship part and also emphasizes the overall knowledge of all combinations of ten, and the next strategy is to make addition of tens.

Learning mathematics with PMRI approach starts from the context or "real" situation ever experienced by students that is a bridge to connect students from real level towards formal mathematics. This is in agreement with the philosophy of RME developed based on the ideas or views of Hans Freudenthal, namely: (1) "mathematics must be connected to reality; and (2) mathematics as human activity" (Zulkardi, 2002). There are three principles and five characteristics in RME (Gravemeijer, 1994; Armanto, 2002; Somakim, 2011).

Dakocan is one of the most famous traditional games in Palembang. This game is similar to the type of game that was in the Bangka, just different names and devices used, namely *Jelentik*. According to the Depdikbud (1985), *Jelentik* is a game that is usually played by children who are in school or have not aimed to train children to know the count. The tool used is the seed of Saga (for Bangka island area), or if none, it can be replaced with other fruit seeds, such as *kecik* (for the Java area, so it called *kecikan*) and Palembang use a plastic doll that more familiar with the name *dakocan*. Furthermore, the mention of games in learning mathematics *dakocan* referred to in this study uses the term *dakomatika*, namely *dakocan* mathematics.

METHOD

This research method is design research. The aim of design research is to formulate Hypothetical Learning Trajectory (HLT), which can be elaborated and refined during the research process. There are several steps undertaken in this study, preliminary design, teaching experiment, and retrospective analysis (Gravemeijer & Cobb, 2006).

In the preliminary design, the researcher studied literature and also formulated a hypothetical learning trajectory consisting three components: learning goals for students, mathematical activities, and hypothesis about the process of the students' learning (Simon & Tzur, 2004). In the teaching experiment, the researcher tested the instructional activities and improved the conjectured learning trajectory. During this phase, data were collected, such as classroom observations, students' interview, and field note. Those data were analyzed in the retrospective analysis phase.

To get the data, study in SDN 98 Palembang, Indonesia, as one of partners' school of PMRI were conducted. Six first grade students were involved in the pilot experiment and thirty-three first grade students were involved in the teaching experiment on a day in October - November, 2012. Video recording and observation reports were used to collect data, also interviewed some students to get deeper information of their thinking process or strategies used.

RESULT AND ANALYSIS

Based on the research that has been done, it can be obtained that students' understanding of the concept of adding number up to 20 can be supported from several activities which are play *dakocan*, put *dakocan* models on a frame 10 *dakomatika*, and solve contextual problems. As well as students' learning trajectories can be generated from informal level to formal level. Furthermore, results and discussion of it can be described as follows.

The Student Understanding of the Concept of Adding Number up to 20

Students' understanding of the concept of adding number up to 20 using *dakocan* traditional game and also the learning trajectory that was produced could be described as follows.

1. Students can understand the concept of adding number through play *dakocan* activities

Students played *dakocan* game with their own group in pairs with the number of *dakocan* at the first is five for each player. But before every student play it in pair, there are two students who voluntarily simulate playing in front of the class with the number of *dakocan* at the first is three. Furthermore, through play such *dakocan* activities students may find the concept of addition and subtraction through direct experience, which is when they encounter event playing to win or lose and describe *dakocan* models respectively. Students may find that winning is the event of increasing the number of original *dakocan* obtained from the number of *dakocan* those obtained previously with *dakocan* after playing.

Likewise for lost event, students may find that losing is the decrease of the number of *dakocan* of many originally obtained from the reduction of some *dakocan* originally belonged to his opponent. Furthermore, teachers can explore the results of the game to guide students to reinvent concepts of addition and subtraction number. The students' understanding level of the concept of addition can be seen from the interviews between student and teacher as follows.

Teacher : "Ok, Class, how the result of game that is played by your friends, who is the winner?"

Student : "Malik"

Teacher : "Why do Malik win?"

Rina : "His *Dakocan* is more"

Teacher : "How many Malik's *dakocan* before played?"

Students : "4"

Teacher : "How many Malik's *dakocan* after played?"

Students :“8”

Teacher :“*Increase or decrease?*”

Students :“*Increase*”

Teacher :“*How many it's increase? How many his win?*”

Students :“8...” then Rina answers “4”

Teacher :“*So, 8 or 4 the win of Malik?*” (The students seem still confused) *From the first time, how many Malik's dakocan?*”

Students :“4”

Teacher :“*Ok, after played the number of Malik's dakocan become 8, so, how many increase of Malik's dakocan?*”

Rina :“4”

Teacher :“*Who is the loser?*”

Students :“*Aditya*”

Teacher :“*Why does Aditya lose?*”

Meyla :“*His dakocan is run out*”

Teacher :“*If lost, which one the number of dakocan, increase or decrease?*”

Students :“*decrease*”

From the exploration of that question, can help students to understand that winning which increases event that represents addition and lost is decreases event as a representation of the subtraction. From this knowledge will help students to understand the case of a play *dakocan* they played with their partner. Furthermore, student activity while playing *dakocan* with each group can be seen in Figure 1.



Figure 1. The Students Played *Dakocan*

Furthermore, the teacher held a class discussion and did ask answer about the games that have been made of each student. For example, to obtain the results of Meyla and Rina group 7-3, with Meyla as the winner and Rina lost. Each student result obtained in playing *dakocan* could help them to

find the concept of increasing items (*dakocan*) as addition and loss/decreasing items (*dakocan*) as a subtraction through the guidance of the teacher.

Then teachers share My *Dakocan* Picture Activity Sheet. By describing the *dakocan* individually before and after playing can help students understand events increases or decreases as the addition or subtraction and can determine how many of that, by comparing the two. In addition, the drawing can stimulate their creativity and ability to create patterns that can be observed from the picture. Basically, the kids were happy with the drawing activity, so they are very enthusiastic in doing so. Furthermore, students' creativity in drawing *dakocan* for win and lost cases can be seen at Figure 2.

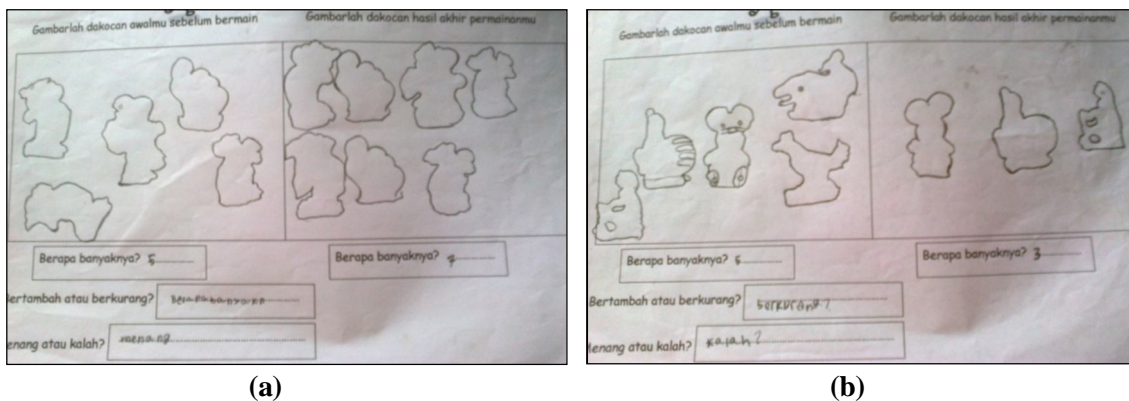


Figure 2. (a) The example of the The Students Result that Win; (b) The example of the The Students Result that Lost

Based on Figure 2.(a), students are able to make model of *dakocan* into the pictures and compare *dakocan* between before play and after play, the number of *dakocan* before playing is 5 and after playing is 7. Means that the number of *dakocan* increases and represents the addition. Furthermore, according to Figure 2.(b), it can be seen that the students are able to make model of *dakocan* in pictures, see *dakocan* drawn on the paper as a representation of numbers and be able to count the number of, and be able to compare it between before and after playing *dakocan*, which originally has 5 *dakocan* and there are 3 *dakocan* after playing. Students are able to determine that their *dakocan* reduced and they lost that is a representation of the concept of subtraction.

After the students had found the concept of addition to the increasing an item from its original condition, and it can be gotten by combining from *dakocan* before and after playing, through students activity sheet these students were given a more general problem, namely the case of a game of others. It is intended to sharpen the students' understanding of the particular to the general case. In this case, students could answer the questions, suggesting they were able to understand the concept of addition and subtraction. The problem was some students still get difficult to write their answers, because they were still learning to write. But there was a solution for this problem that was teacher guided the students to write the answer by telling the letters forming the word in question.

2. Students can Understand the Relationship between Numbers Forming the Pair Numbers of 10 through Put Dakocan Models on the Frame 10 Dakomatika Activity

Students can understand the relationship between numbers, the combination of ten, through the activity of put *dakocan* model on the frame 10 *dakomatika*. They can find out and record the numbers forming couples of 10 to work on a few questions on the activity in students activity sheet completed by the *dakocan* model to the frame 10 *dakomatika* in group then presented it in front of the class.

Furthermore, to determine the students' understanding of the material learned in the class in this activity, an analysis of students' answers to the questions on student activity sheet. Based on the results of the analysis of student work, there are two types of mistakes made by students in working on number 1. The first error is the error in the put the *dakocan* model and the second error is in the calculation. From the 15 groups, there is one group that is still get error in put the *dakocan* model to frame ten and one group is wrong in adding the relevant numbers affixed *dakocan* models, and the others were able to answer this student activity sheet correctly.

The group who still get error in calculating the number of *dakocan* models that is put is Rahma and Salsabila group. They got it right in put it, either color or number. But they made a mistake when filling out the number of *dakocan* models put. To red model *dakocan* in figure 1 is 3, but they wrote as 6. And they wrote down the number of *dakocan* models in figure 2 by 7 which consists of 5 green and 2 red is correct. So the group Rahma and Salsabila count as $6 + 7 = 13$. The results of the calculations correctly, but it does not fit with the figure, which should be $3 + 7 = 10$. For the second type of error made by the Tiara group. They are wrong in put *dakocan* models, there are 3 red models in figure 1 but they put 4 red *dakocan* models, and for the second figure there are 7 models *dakocan* consisting of 2 red and 5 green, but they put 1 red and 5 green. So that is put became $4 + 6$, but they wrote $3 + 7 = 10$.

After the interviews, some of these errors were caused by less conscientious students in viewing figure and counting. However, after a class discussion held, they realized their own mistakes and can correct it.

Furthermore, students communicated all the results they had obtained in filling the table provided on the frame 10 on the student activity sheet with the manipulative of frame ten *dakomatika* and *dakocan* models provided. Then, the results of the students' work in put *dakocan* models and determine combination of ten can be seen at Figure 3.

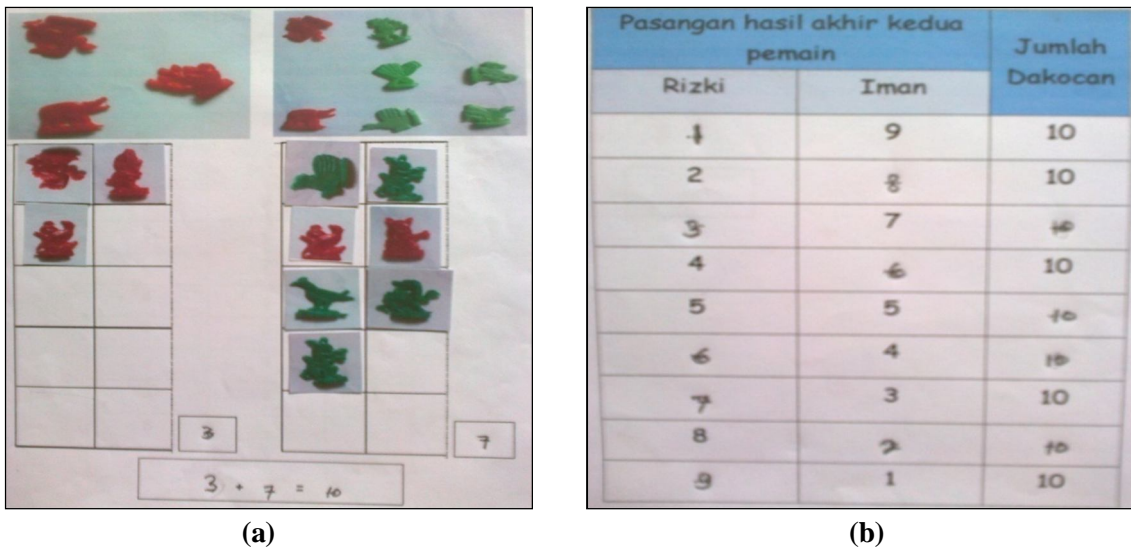


Figure 3. (a) The Example of Students' Work in Put Dakocan Model; (b) The Example of Students' Work in Determine Pair Numbers Forming 10

Having conducted interviews with students, They could fill all the numbers forming 10 or combination of ten with the help of frame ten *dakomatika*. From this case, it can be seen that the frame 10 *dakomatika* can assist students in determining the number pair forming 10 or combination of ten.

Furthermore, the examples of strategies used by students in solving addition can be seen at Figure 4.

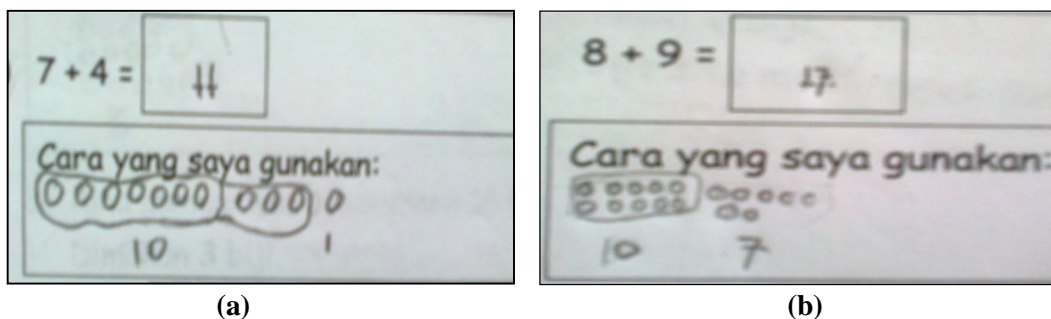


Figure 4. (a) The example of Strategy Used by Khofifah; (b) The example of Strategy Used by Anggi

Based on Figure 4. it can be known that strategy used by Khofifah and Anggi in the adding number. Strategies used Khofifah through the symbol that original circle pattern yet, but she has been able to classify into tens. Khofifah still remember the material studied is forming pair number of 10. So she worked to make the 7 circles and next to it there are 4 circles lined up, and then grouped into 7 and 3 will form 10, thus obtained 10 and 1 that make 11. This sample of strategy can be seen at Figure 4.(a).

Such a strategy is also found in Anggi in working $8 + 9$. Anggi used a strategy double and tens. When she was asked, Anggi grouped into 10 from 9 and 1, then arranged it in the form of circles

become 5, 5, and then wrote down as many as 7 other circles, so that $8 + 9$ equals 10 and 7, which is make 17. This strategy can be seen at Figure 4.(b).

Some examples of strategies used by students showed that they can understand the relationship between number like double and forming ten and also can apply this concept to solve contextual problems related adding number up to 20 by using model with a little guidance from the teacher.

Through a series of activities, students could understand the relationship between numbers, it is combination of ten to find and determine the number pairs forming 10 that filled in the table through the activity of put the *dakocan* model to the frame 10 *dakomatika*. In addition, students are also able to construct a double strategy in the addition through symbol. This ability is further expected to be used by students to solve the problem of the adding number up to 20.

3. The Students could Solve Contextual Problem related to Adding Number up to 20

The students could understand the concept of addition and subtraction number then they could apply it to solve the contextual problems related to addition number up to 20. Through the playing a role activity related to the addition number that was "giving gift". Through that activity students could construct their ability to solve problems in daily life. Furthermore, the form of ask answer between teacher and students shows that students were able to solve contextual problem related to addition number up to 20 as follows.

Teacher :*"Ok Class, after viewing your friends' playing role of giving gift, how many Ridwan's balls originally?"*

Students :*"9"*

Teacher :*"Having given gift by 5 balls, how many Ridwan's balls right now?"*

Anggi :*"14"*

Teacher :*"Ok, good! How do you get it?"*

Anggi :*"adding it"*

Teacher :*"Well! Anggi, write down the answer to the board, please."*

Then Anggi answered it to the front of class to show the strategies she used to her friends in class. Anggi strategies to solve the problem by using symbolic of circle patterned then wrote it into formal mathematics. Anggi used double strategy and combination of ten, by writing the number of Ridwan's balls originally, there are 9 dots arranged as 4, 4, 1 and 5 dots arranged then produced 5, 5, 4 to make 14. Then, Anggi answered this problem can be seen at Figure 5.

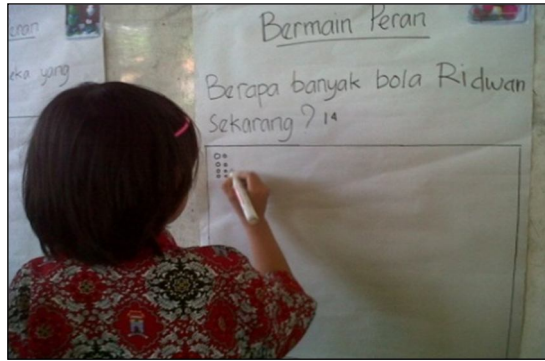


Figure 5. Anggi Answered Contextual Problem

The next activity is the students' ability to construct contextual problem solving by working on a few questions on the students activity sheet in groups. They learned to read about and try to understand it by the guidance of teachers. The role of the teacher in this session is limited in helping them reading question when there were students who cannot read. Then the students decided how to solve the problem at the student activity sheet by themselves.

The students were very enthusiastic in communicating their opinion in the discussion with their group and then wrote the results to the student activity sheet. After finishing the discussion the students presented the results of their discussion to the class and the other gave respond by guidance from the teacher. Students were excited in a presentation to the class, because they can learn to communicate their opinion and discuss it classically.

After carrying out activities designed and discussions both in the classical and group in solving some of the problems in the student activity sheet, it was known that students could understand the concept of adding number up to 20 and use it to solve contextual problems. Therefore, this activity could support the students' understanding of the concept of adding number up to 20 and solving contextual problem strongly.

Learning Trajectory of Adding Number up to 20

Based on some activities done, can be gotten learning trajectory that is expected to be used in developing learning instructional theory of adding number up to 20. Furthermore, this learning trajectory using *dakocan* traditional game can be used to help students' understanding concept of adding number up to 20 from informal level to formal level. Then, learning trajectory of adding number up to 20 can be seen at Figure 6.

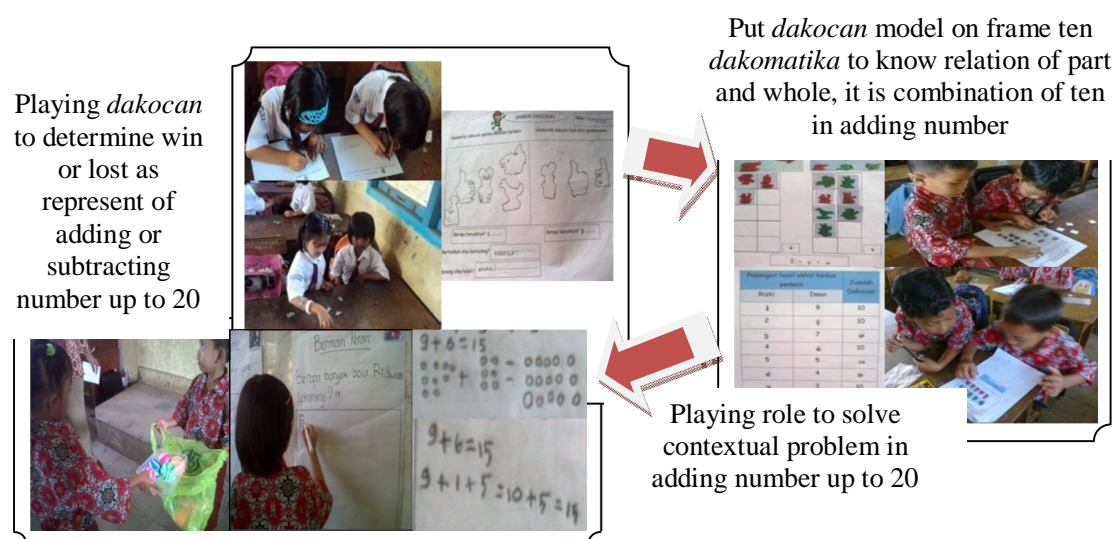


Figure 6. Learning Trajectory of Adding Number up to 20 Using *Dakocan*

CONCLUSION

As expected, the first grade students' understanding of adding and subtracting number up to 20 can be supported using traditional game. The students' understanding can be developed from informal level to the formal level. Students can reinvent concept of adding number up to from their experience in playing *dakocan* traditional game. Learning number by using *dakocan* and PMRI approach can stimulate students' understanding about number relation like combination of ten, and they can use their understanding that concept to solve contextual problem related to adding number up to 20.

Likewise, learning trajectory resulted to support students thinking strategy as a model consist of playing *dakocan* together, frame ten *dakomatika*, and solving contextual problem related to adding number up to 20.

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