

Learning Multiplication Using Indonesian Traditional game in Third Grade

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Abstract

Several previous researches showed that students had difficulty in understanding the basic concept of multiplication. Students are more likely to be introduced by using formula without involving the concept itself. This underlies the researcher to design a learning trajectory of learning multiplication using Permainan Tradisional Tepuk Bergambar (PT2B) as a context based on the student experience. The purpose of this research is to look at the role of PT2B in helping students' understanding in learning multiplication, which evolved from the informal to formal level in third grade with Pendidikan Matematika Realistik Indonesia (PMRI) approach. The method used is design research starting from preliminary design, teaching experiments, and retrospective analysis. This research describes how PT2B make a real contribution to the third grade students of SDN 179 Palembang to understand the concept of multiplication. The results showed PT2B context can stimulate students to understand their knowledge of the multiplication concept. The whole strategy and model that students discover, describe, and discuss shows how the students construction or contribution can uses to help their initial understanding of that concept. The stages in the learning trajectory of student have an important role in understanding the concept of the operation number from informal to the formal level.

Keyword: Design Research, PMRI, Multiplication, *Permainan Tradisional Tepuk Bergambar*

Abstrak

Beberapa penelitian sebelumnya menunjukkan bahwa siswa mengalami kesulitan dalam pemahaman konsep dasar operasi perkalian. Siswa lebih cenderung dikenalkan dengan penggunaan rumus tanpa melibatkan konsep itu sendiri. Hal ini mendasari peneliti untuk mendesain suatu pembelajaran operasi perkalian menggunakan konteks Permainan Tradisional Tepuk Bergambar (PT2B) berdasarkan pengalaman siswa (*experience-based activities*). Tujuan dari penelitian ini adalah untuk melihat peranan PT2B dalam membantu pemahaman siswa akan konsep dasar operasi perkalian, yang berkembang dari bentuk informal ke bentuk formal di kelas III dengan pendekatan Pendidikan Matematika Realistik Indonesia (PMRI). Metode yang digunakan adalah *design research* dengan tahap *preliminary design*, *teaching experiment*, dan *retrospective analysis*. Penelitian ini mendeskripsikan bagaimana PT2B memberikan kontribusi nyata pada siswa kelas III A SDN 179 Palembang untuk memahami konsep operasi perkalian. Hasilnya menunjukkan bahwa konteks PT2B dapat merangsang siswa untuk memahami pengetahuan mereka tentang konsep perkalian. Seluruh strategi dan model yang siswa

temukan, gambarkan serta diskusikan menunjukkan bagaimana konstruksi atau kontribusi siswa dapat digunakan untuk membantu pemahaman awal mereka tentang konsep perkalian. Tahapan-tahapan dalam lintasan belajar siswa memiliki peranan penting dalam memahami konsep operasi perkalian dari level informal ke formal.

Kata Kunci: *Design Research*, PMRI, Operasi Perkalian, Permainan Tradisional Tepuk Bergambar

Introduction

Reform in education has spawned several new paradigms, both in terms of curriculum, teacher's quality, and students themselves, which will result the qualified teacher working in a professional and highly educated (Whitman, 2011). It means that each teacher should be able to innovate in teaching and learning, so learning is produced in accordance with the development of education.

One of the innovations in learning mathematics is to use context as a starting point in the learning process. In the other words, as the basis of students' knowledge, the context becomes the first step to learning mathematics (Zulkardi and Ratu Ilma, 2006), one of which is the *Permainan Tradisional Tepuk Bergambar* (PT2B) context in the learning numbers operation. Learning numbers in the primary level is important for learning the other topics (Freudhental, 1973; NCTM, 2000), therefore, learning number operation, especially multiplication at the primary level becomes one of the prerequisite knowledge, which must be owned by students, to step into the next topic of learning mathematics.

Based on classroom observations conducted by researcher on subjects mathematics classroom observation, researcher found the students have learning difficulties in the calculation of units in the fourth grade, so the researcher think it looks like there is something wrong in a learning multiplication at the third grade in that school. Problems in the teaching of mathematics such as this has been investigated by Nasrullah (2011) and Kairuddin (2011), with the conclusion is PMRI approach through the right context, can solve the above problems. In addition, coordination with the classroom teacher as research progresses it becomes important to achieve successful learning (Charitas, 2010).

Theoretical Framework

In this research, literature was studied to find out what former studies have shown about the development of students' understanding of multiplication. Furthermore, this literature is also useful as a basis to design a sequence of instructional activities about multiplication. Since it was designed under the PMRI environment, the literature about PMRI is also needed to explain and to investigate how the contextual situations could be shifted to more formal mathematics.

1. Multiplication as a repeated addition

Integer operations that we know are addition, subtraction, multiplication, and division, where the four operations have any connection with each other, as described in the book *Helping Children Learn Mathematics*. The following four relations operation that has a relationship with each other, and students must understand the relationships in that book (see in page 92).

There are several ways to teach the concept of integer operations in the learning of mathematics, among others, with PT2B context. Its context is used as an initial step in this research, where the process of winning and losing in this game can be attributed to the operations of addition and subtraction, as well as the number of wins a victory by the number of consecutive or more than one player can also be connected with the operation of multiplication and defeat occurring in sequence may be associated with the operation of division. However, the focus issue for this paper is talking about multiplication as a repeated addition.

2. PMRI (Indonesian version of Realistic Mathematics Education)

The philosophy of PMRI is an adaptation of the RME philosophy based on the ideas explored and developed by Hans Freudenthal. Two important views of him are (1) mathematics must be connected to reality; and (2) mathematics as human activity (Zulkardi, 2002). In the process of doing mathematics, Freudenthal (1991) emphasizes that students should be allowed and encouraged to invent their own idea and use their own strategies. In the other words, they have to learn mathematics in their own way. Instead of giving algorithms, mathematics should be taught in the way where students can do and experience to grasp the concepts. Therefore, this study develops an instructional unit on teaching and learning multiplication in which the students could gain more insight about how to solve the multiplication problem as a repeated addition

problem through experiencing a sequence of meaningful activities (PT2B, red) instead of only memorizing the algorithms of multiplication.

Hadi (2005) stated learning mathematics with PMRI approach includes the following aspects:

1. Start the lesson by posing the real problem for students according to level of experience and knowledge, so that students are immediately engaged in a meaningful lesson.
2. The problems given course must be submitted in accordance with the goal achieved in the lesson.
3. Students develop or create symbolic models informally on issues/problems presented.
4. Teaching takes place in an interactive that students explain and give reasons for their answer, understand the answers of their friends (other students, red), agreed or disagreed to their friend answer, look for other alternative solutions, and reflect on each step taken by or the results of the lesson come from.

3. PT2B context

According to Sucipto (2003), PT2B is a game that is usually preferred by boys, where the players involved in this game is two people or more, and before playing, they should have a number of picture cards that later they will play. Picture cards made of thin cardboard with a variety of image models, such as those typically seen in children's films that are popular on television. Drawing sheets filled only one part, the other is empty (not illustrated, red), with a very diverse sizes (small and large, red). PT2B does not require special skills of the players. The important thing is he can choose a great picture card which is always open in that picture part. Luck factor becomes the single most decisive in PT2B.

How to play PT2B was quite easy, first of all players choose one of the most favored picture card to be played. They put the picture card on the right palm open. Both palms are lodged and then withdrawn. At that time, a picture card fell off and floated down. The picture card that get to the bottom with an open position (image part shown, red) was declared the winner, with his opponent drawing a closed condition, whereas, if the two images are equally open or closed, then the game declared a draw. On the other hand, if the number of players more than 2 people, usually, a picture card which is

seeded to play will be collected, then flown into the air. The number of images that are open will be flown again, until the rest of the image is open, and he was declared the winner. Players who lose have to give the player who wins with a number of picture cards that have been agreed. The game ends when all parties are playing, agreed to stop. Won and lost condition in this game can be attributed to the basic concepts of addition and subtraction, as well as victory and defeat that occur in sequence, can also be connected with the basic concepts of multiplication and division.

4. Emergent Perspective

Before starting the learning process, it is conjectured that the students have their own belief about their own roles, the others' roles, the teacher's roles and the mathematics that will be learnt. In this research, during the process of learning, the teacher will initiate and develop the social norms that sustain classroom culture characterized by explanation and justification of solution, and argumentation: attempting to make sense of explanation given by others, indicating agreement and disagreement, and questioning alternatives in solutions in which a conflict in interpretation or solution has become apparent (Gravemeijer & Cobb, 2006).

Based on Shintia's research (2011) that I reference in this learning process, we will focus on the normative aspect of mathematics discussion specific to students' mathematical activity. To clarify this distinction, we will use the term socio-mathematical norms rather than social norms. We describe socio-mathematics norms as normative understanding of what counts as mathematically different, mathematically sophisticated, an acceptable mathematical explanation and justification. Students will develop their ways of judging, whether a solution is efficient or different, and the teacher is not the only one who decides the acceptable solutions. In this way, socio-mathematical norms are negotiated as the teacher and students participated in the discussions.

Hypothetical Learning Trajectory

Hypothetical learning trajectory (HLT) is proposed as a term to identify and describe relevant aspects associated with a mathematics lesson plan, including: A description of the students' mathematical goals, the mathematical activities (including the tasks or problems, that students will work on to achieve the goals), and a hypothetical path that describes the students learning process (Shintia, 2011). The HLT in this study had

several learning goals expected to be reached by the students during a week study. To reach the goals formulated, we design a sequence of instructional learning for learn multiplication which is elaborated on the following table:

Table 1. Overview of the HLT

Sequence of Activities	Goals	Descriptions
Playing PT2B that modified the role	Students can use PT2B as a starting point in learning multiplication	<ul style="list-style-type: none"> • In this game, it takes 2 groups, where each group consists of two students. A person from each group is standing in front of the box that already contains a pack of picture card and the other is playing PT2B represented their group. For the winning team, the group members who stand in front of the box that contains a pack of picture cards have been forward one box and take a picture card in that box. They played 7 times.
Solving PT2B activities problems in groups	Students can solve PT2B activities problems in groups by constructing their experience when they play PT2B	<ul style="list-style-type: none"> • Before distributing student worksheets to each group, teacher and student must have same perception about the role of this game that has been modified, to avoid mistakes in solving the problems given in student worksheets in this activity. • After all students have a perception about the game that has been modified, teacher distributed worksheets to each group and provide a timeline for solve student worksheet in \pm 20 minutes. • Furthermore, teacher invites each group to present their answer in front of the class.
Discussion to construct the basic concept of multiplication as a repeated addition	Students can construct the basic concept of multiplication as a repeated addition	<ul style="list-style-type: none"> • Teacher guide students from the existing problems into formal operation of multiplication, which is basically the multiplication operation is the process of repeated addition or victories that taken over and over again as they did in the PT2B game that has been modified the rule.
Evaluation	Determine the student ability in learning multiplication	<ul style="list-style-type: none"> • Teacher evaluates the student about multiplication problem in the formal and informal form that different with PT2B context problem.

Methods

1. Participants

We work with a teacher and 26 third grade students of SD N 179 Palembang (fourteen boys and twelve girls). The students are on age 7 to 8. In each lesson they worked in

groups of 4 or 5. The teacher classified the students based on academic ability and gender. So, in each group there are high achievers, average students, and also low achievers.

2. Materials and Procedure

Therefore, the researcher made this research with the aim to enhance students' understanding of the concept of multiplication in third grade elementary school using the PT2B as the context and generate learning trajectories numbers operation using PT2B, which evolved from the informal to formal level in third grade elementary school, involving 26 students of SD N 179 Palembang.

As the main goal of this research, we designed the activities for the students to know how they can use PT2B as a starting point in learning multiplication, to investigate their ability in connecting their playing experience with the basic concept of multiplication as a repeated addition, and how they solve the multiplication task related to a repeated addition.

As mentioned in my HLT, each lesson brings some essential features that are as my expectations. We would look into students' ability of reasoning. Therefore, the result will be analyzed qualitatively. The reliability of this design research is, of course, accomplished in qualitative way. The qualitative reliability is conducted in two ways, data triangulation and cross interpretation. The data triangulation in this study involves different sources: the videotaping of the activities, the students' works and field notes. The parts of the data of this research will be also cross interpreted with observers. This is conducted to reduce the subjectivity of the researcher's point of view.

Results and Analysis

1. The activity of PT2B that have been modified as a starting point for learning multiplication

The activity in this study, using PT2B that has been modified the rules, so it can be used as a starting point in learning multiplication. In this game, it takes 2 groups, where each group consists of two students. One person from each group is standing in front of the box that already contains a pack of picture card and the other is playing PT2B represented their group. For the winning team, the group members who stand in front of the box that contains a pack of picture cards have been forward one box and take a picture card in that box, as shown in Figure 1.



Figure 1. The member of the group standing in front of the box containing a deck of picture cards (left) and the other group members are playing PT2B (right)

After play the game 7 times, evidently, Dovan's group won 6 times and Ghifara's group won 1 times, where as has been stated above, each deck of picture cards inside the box contains 50 picture cards. So, after playing Dovan's group represented by Saed, write down the results they get a picture card as seen in Figure 2.



Figure 2. Saed count his group picture card (left) and the teacher clarify the Saed's answer to his classmates (right)

2. The introduction of the basic concept of multiplication as repeated addition using PT2B

Further activity, the teacher asks the students about how to calculate the whole picture cards that has Dovan's group got, such as the following dialogue:

Teacher : How many steps are Dovan forward? Six, students' answer

Teacher : So, how many times is Dovan won?

Student : Six, said students at the same time

Teacher : Ghifara's group? One students' answer

Teacher : Now, let's see, how does the final count?

Student : Three hundred, said Raihan

Teacher : How is it calculated?

Student : One hundred, two hundred, three hundred, said students at the same time

From the students' responses, it appears that students do grouping the answers into hundred, it's because the amount produced amounted to 50 picture cards. So, it would be more easily calculated, if they group them into hundreds first. After conducting a simulation of PT2B that has been modified, students sat back down on groups that have been shared by teachers in early learning, where each group consists of ± 4 students. The dialogue above is necessary before teacher distribute student worksheets, it's because not all students feel playing PT2B that has been modified, so the teacher first must make the same perception of students about this game, to avoid mistakes in solving the problems given in the student worksheets in this activity. After all students have a perception about the game that has been modified, teacher distributed worksheets to each group and provide a timeline for solve student worksheet in ± 20 minutes as seen in Figure 3.



Figure 3. The students work in their groups

Furthermore, teacher invite each group to present their answer in front of the class, and this time Dovan's group get a chance to present his group's answer in front of the class as seen in Figure 4.



Figure 4. Dovan's group presents their answer

At this the presentation session, there was no discussion is quite active. This is because most of the answers of each group same with the answers displayed by Dovan's group (see in Figure 5), such as the following dialogue:

Teacher : The all answer is same.

Teacher : How the end result of Anton? Ask the teacher to the Dovan's group

Student : Three hundred.

Teacher : Who wins?

Student : Anton.

Teacher : Dovan's group said that the winner is Anton. There is there any different answer from this?

Student : No, said students simultaneously.

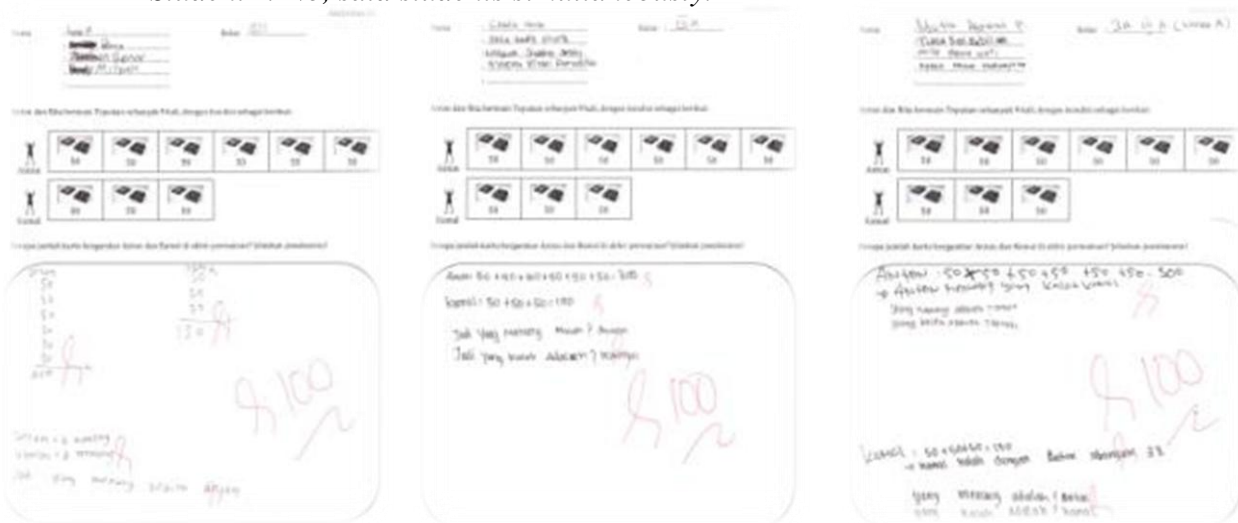


Figure 5. Some of the students' answer

From the dialogue above, it can be seen that all students have had the same perception about this new game, so that they can solve problems that are given as well. Teacher gives another student worksheets to each group with more complex problems to test their understanding of the game and also led them into the form of formal multiplication. The results appear a few strategies as shown in the Figure 6.



Figure 6. Some of the students' answer

In this activity, it led to discussion that I expected, where as the Oca's group doing presentations on the second issue given, Panca's group has different answers following its strategy, as shown in the following dialogue:

Teacher : Is there a difference?

Student : Yes mam, said some students.

Teacher : Where's the difference?

Student : This is, says one group

Teacher : Please, Panca's group tries to see where's the difference?

Now, we compare between Oca's group work and Panca's group work.

Attention, Oca's group, how many times Rita win?

one, two, three, four, five. Is it true?

Student : Yes, said the group asked.

Teacher : Is that right five times?

Student : No, Panca said represented by his group.

No ma'am followed the other groups.

Teacher : Look, there are pictures of people, one, two, three, four, and the fifth pictures of people win. That's rights. That's a picture card or a picture of a win person, isn't it?

Now, please see again, in the fifth column is the people picture or a card picture?

Student : People, said most of the students

Teacher : So, how many times she won it?

Students : Four, students answered at the same time.

Teacher : Now, let's see. Perhaps, you are confused, this people or card picture? Isn't it?

Student : Yes, students answered

Teacher : Okay, it is important if we count people, give his statement. People including those calculated.

Student : Yes ma'am, answered students simultaneously.

From this discussion, it appears that the main problems faced by students, not because of a miscalculation, but a wrong perception of picture cards are counted or not based on the rendered image on the matter as shown in the Figure 7.

The whiteboard contains a table with two rows: RITA and KAMAL. Each row has ten columns, each containing the number 30. Below the table, there are three parts: A, B, and C. Part A says 'Rita Menang 5 kali dan, Kamal Menang 9 kali'. Part B shows calculations: 'Rita: 30+30+30+30+30=150 kartu.' and 'Kamal: 30+30+30+30+30+30+30+30+30+30=270 kartu.'. Part C says 'Jadi biaya Rita 150+30+30=210 kartu.'. To the right, there is a smaller table with two rows: RITA and KAMAL. The RITA row has five 30s and five empty cells. The KAMAL row has five 30s and five empty cells. This smaller table is circled in black.

RITA	30	30	30	30	30					
KAMAL	30	30	30	30	30	30	30	30	30	30

A Rita Menang 5 kali dan,
Kamal Menang 9 kali.

B Rita: $30+30+30+30+30=150$ kartu.
Kamal: $30+30+30+30+30+30+30+30+30+30=270$ kartu.

C Jadi biaya Rita 150+30+30=210 kartu.

RITA	30	30	30	30	30				
KAMAL	30	30	30	30	30				

Rita menang 5 kali dan
sedangkan kamal menang 9 kali

Figure 7. The answer of Oca's group (all answer in whiteboard except in that circle) and the answer of Panca's group (answers circled)

After a long discussion process, teacher tries to guide students from the existing problems into formal operation of multiplication, which is basically the multiplication operation is the process of repeated addition or victories which get over and over again as they did in the PT2B modified the rules of this game. For more details, can be seen modeling of the student guided by teacher in Figure 8.

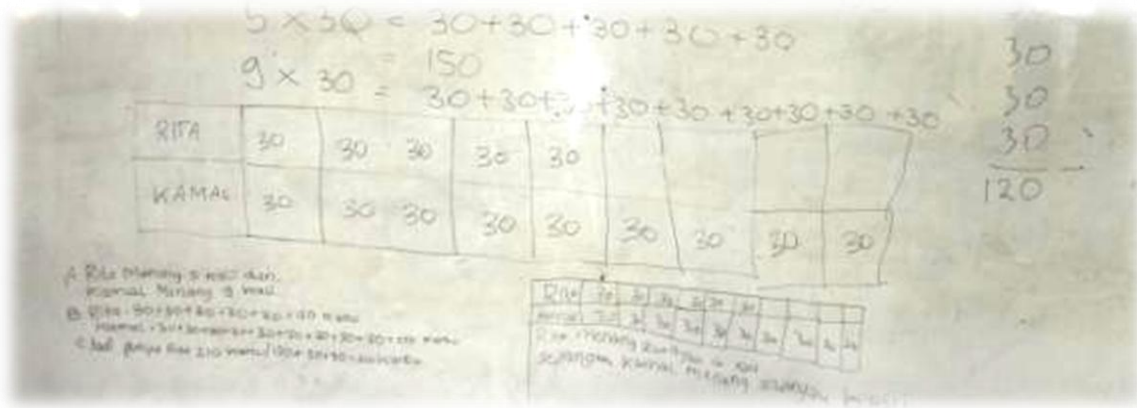


Figure 8. the process of multiplication operation from repeated addition to a formal multiplication operation form

3. Solving multiplication operation problems either as a formal task or a real problems based on the context of everyday problems

This last activity, ending with an evaluation about the multiplication in the form of formal and informal task that not have relationship with PT2B context. From the results of this evaluation, there are some interesting things that are good for discussion, including the following.

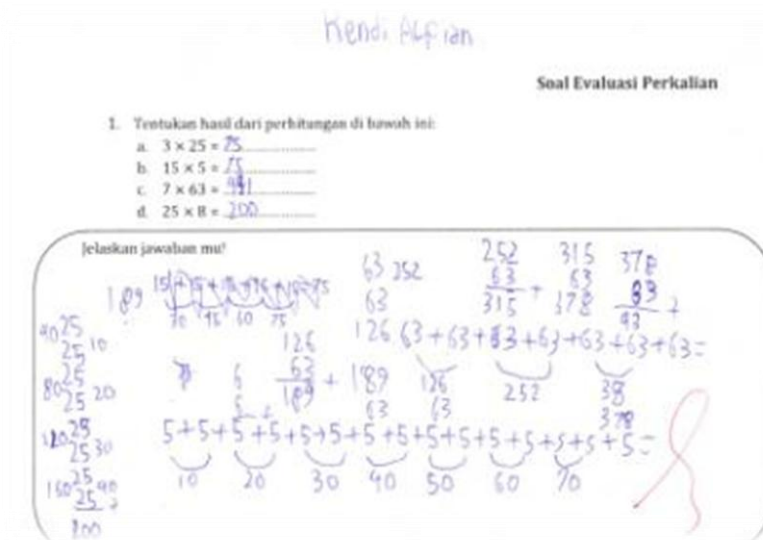


Figure 9. the process of multiplication operation from repeated addition to a formal multiplication operation form

Rendi evaluation results, as shown in Figure 9, it's very satisfying, where Rendi have grasped the basic concepts of multiplication which is the repeated addition with a very careful calculation process by using a calculation of two numbers in sequence, which would minimize the error, so that the result is an answers that as expected.

In the other hand, researchers also found the result of the student evaluation which uses a process based on the concept of multiplication directly without a good understanding about it, so the result is quite disappointing, as shown in Figure 10. In her answer, Ghifara has many mistakes in the multiplication process. This is obtained when in the interview process. Apparently, Ghifara write directly the result of multiplication as an answer, for example $63 \times 7 = 421$ ($7 \times 3 = 21$, he wrote one on the back, then $6 \times 7 = 42$, written on the front) and $25 \times 8 = 160$ ($5 \times 8 = 40$, he wrote down the 0 on the back, then $2 \times 8 = 16$, written on the front). Finally, after getting guidance, she understands her mistake that she did and promptly correct answer.

nama: Ghifara Riqqoni
kelas: III A

Soal Evaluasi Perkalian

1. Tentukan hasil dari perhitungan di bawah ini:

a. $3 \times 25 = \underline{100}$ 415
b. $15 \times 5 = \underline{150}$ 75
c. $7 \times 63 = \underline{200}$ 441
d. $25 \times 8 = \underline{160}$ 200

Jelaskan jawaban mu!

a. $\begin{array}{r} 25 \\ 3 \cdot \\ \hline 75 \end{array}$ b. $\begin{array}{r} 15 \ 2 \\ 5 \cdot \\ \hline 75 \end{array}$ c. $\begin{array}{r} 63 \ 2 \\ 7 \cdot \\ \hline 421 \end{array}$ d. $\begin{array}{r} 25 \ 4 \\ 8 \cdot \\ \hline 200 \end{array}$

$\begin{array}{r} 63 \ 2 \\ 7 \cdot \\ \hline 441 \end{array}$ $\begin{array}{r} 25 \ 4 \\ 8 \cdot \\ \hline 200 \end{array}$

Figure 10. Ghifara evaluation results (the circled answer is the answer after the interview process)

From all the results of this evaluation, researchers found a very good answer, where students are able to perform calculations with very little strategy to make mistakes, in addition to the basic concept of multiplication as repeated addition, which is the important understanding to her in solving this problem. The name of the student is Salwa and there is her answer as shown in Figure 11.

(model of and model for), and general (formal) level. After achieving some basic concepts of multiplication, students are able to resolve the issue at a formal level by using their knowledge and experience at the level of situational, referential, and general. Of all the activities through which students, researcher can state that students can grasp the basic concepts of multiplication as a repeated addition that are designed based on the learning trajectory with PT2B as starting point.

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