

PRE-SERVICE ELEMENTARY TEACHERS' WRITTEN COMMUNICATIONS: EXPLAINING MULTIPLICATION USING AREA REPRESENTATIONS

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Abstract

This research was conducted to propose pre-service elementary teachers' (PsET) written communication in explaining multiplication representation, especially using area representation. Communication has an important role in learning process. Through communication, one can show or confirm his or her knowledge. The subjects of this research were 9 university students as the PsET. The subjects were asked to write the explanation of multiplication using area representation on a paper. After that, the researcher confirmed it by asking the subjects to re-explain that mentioned representation on a board as if they really taught elementary school students. From the result of this research, it is identified three main findings that can be obtained from written communication of the PsET, they are 1) expressing procedural and conceptual knowledge, 2) expressing ability in constructing connection, and 3) improving the confidence of PsET.

Keywords: written communication, pre-service elementary teachers (PsET), multiplication using area representations

INTRODUCTION

Mathematics learning in elementary school basically provides students with the basic mathematics skill. This skill is needed not only to learn mathematics in higher level, but also to apply it in daily life (Claessens & Engel, 2013; NCTM, 2000; Zanini & Benton, 2015).

Teaching mathematics is not only merely teaching about calculating. Calculation can be done using various programs and calculation tools, such as calculator or computer that work faster and more accurate (NCTM, 2000). Teaching mathematics means helping students to understand mathematics and use that knowledge to solve problems. In teaching mathematics, it is not enough for the pre-service elementary teachers (PsET) to only have procedural knowledge, yet they also have to master conceptual knowledge. They need to understand the mathematics concept in order to be more flexible in teaching it to the students (NCTM, 2000; Soto-Johnson, Cribari, & Wheeler, 2009; Thanheiser, 2010; Whitacre & Nickerson, 2016; Yang, 2007).

Communication is a salient part both in mathematics and mathematics education. Through communication, a PsET can perform and confirm his or her ability in problem solving, reason and proof a mathematics statement, connect various mathematical concepts, or use various mathematics representations. When someone speaks or writes any information, he or she can obtain knowledge. When someone speaks or writes about something, it means he or she delivers knowledge to other people or public (Ernest, 2004; NCTM, 2000; Thompson & Chappell, 2007).

Speaking, listening, writing, and reading are communication models that should emerge sequentially in mathematics class (Thompson & Chappell, 2007). Mathematics PsET should always be

supported to communicate their knowledge in a classroom. Through this communication, they could receive either feedback or support, so it can enrich their learning experience.

Written communication has been employed in some researches (Fuehrer, 2009; Kostos & Shin, 2010; Soto-Johnson et al., 2009; Wil, Nico, & E, 2015). Wil et al. (2015) employed written communication that was called written reflection to see how the pre-service teachers use theory in explaining a learning practice in the classroom. Soto-Johnson et al. (2009) showed that written reflection can improve the mathematics learning achievement for pre-service teachers, help pre-service teacher to reflect the learning method, and assess the understanding of pre-service teachers. Fuehrer (2009) employed written communication in mathematics learning in the classroom to enhance the use of vocabulary in mathematics learning achievement. Kostos & Shin (2010) used written communication in journal to improve the students' ability in communicating mathematics thinking. Written communication has been employed as a tools to see the pre-service teachers' certain abilities (Wil et al., 2015) or to improve certain aspects (Fuehrer, 2009; Kostos & Shin, 2010; Soto-Johnson et al., 2009). There has been no research that focusing on written communication it self, not as a tool. This research explored pre-service teachers' written communication, how did they use written communication to explain their thinking or their ideas.

The PsET have different academic background and mathematics point of view. Their communication and mathematics thinking skill are also poor (Suryadi, Sumarmo, & Rakhmat, 2014). Even though they have poor mathematics ability does not mean they do not have it at all. The prior knowledge of these pre-service teachers can be productively conducted through learning process. Whitacre & Nickerson (2016) shows how prior knowledge of pre-service teachers can be employed to reason multi-representation of multiplication and associate it with standard algorithm.

The pre-service teachers can be asked to explain a concept or mathematics representation through written communication. In explaining something in written communication, it is demanded to really master what it is written and give a chance to use the right terms/vocabularies (Fuehrer, 2009; Kostos & Shin, 2010). Moreover, by written communication, one can be more flexible in expressing their idea without feeling worried or embarrassed (Kostos & Shin, 2010). The pre-service teachers can also do reflection by re-reading or discussing their writing to the lecturers or classmates. The explanation in the writing can be corrected or explored.

Multiplication of two numbers has various representations, such as multi digits multiplication model, grid model, product partial model, Lattice model, or area model. So far, the pre-service teachers really rely on the standard algorithm (Thanheiser, 2010; Yang, 2007). Teachers' mathematical understanding can be assessed through written communication created to explaining a representation.

The question in this research was how did the pre-service elementary teachers' written communication in explaining multiplication using area representations?

METHODS

This research used qualitative approach with exploratory descriptive method. This research was conducted to describe written communication for PsET in explaining a representation. The representation discussed in this research focused on multiplication using area model.

There were 9 PsET who participated as the research subjects. They were S1, S2, S3, S4, S5, S6, S7, S8, and S9. The subjects were the university students in semester 4 in a private university in Makassar. These subjects were selected in consideration that students in semester 4 already perceived basic mathematics concept and its learning in elementary school. However multi representation of multiplication is not part of the course. So far, PsET are used to use standard algorithm to multiply two number with two digit.

Data collection was carried out by giving written communication test related to multiplication using area representation. The researcher used a week to analyze the result of subjects' written communication test and write down some important aspect that might be asked in interview session. After a week, the subjects were requested to re-explain that mentioned representation on a board as if they really taught elementary school students. After explanation session, it was conducted non-structured interview. The data analysis was focused on the PsET's explanation about representation and its relation to other representations or other mathematics concepts. Figure 1 shows the written communication test.

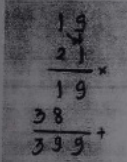
**INSTRUMEN AWAL
KOMUNIKASI TULIS CALON GURU**

Petunjuk instrumen:

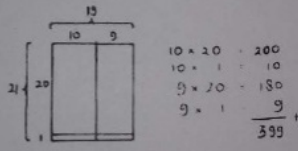
1. Tuliskan NIM dan nomor telepon Anda pada lembar jawaban yang telah disediakan!
2. Perhatikan dua metode perkalian yang disajikan berikut ini dan jawablah pertanyaan yang diajukan pada lembar jawaban yang telah disediakan!

Metode Perkalian

Metode Standar
(Downward Algorithm)



Metode Luas Daerah



Pertanyaan

1. Tentukan hasil dari 23×45 dengan menggunakan metode standar dan metode luas daerah!
2. Jika Anda diminta menjelaskan metode luas daerah kepada siswa, uraikanlah apa yang Anda akan kemukakan kepada siswa!

Terima kasih atas partisipasi Anda BOBODO

Figure 1. Instrument of Written Communication

RESULTS AND DISCUSSION

Written communication of PsET can express their mathematics understanding. They can express their knowledge and opinion by written communication without feeling worried or embarrassed if they make a mistake. Besides, the PsET can re-read and correct their writing. This research identifies three main findings which can be obtained from written communication of PsET, they are; 1) expressing procedural and conceptual knowledge, 2) expressing ability in constructing connection, and 3) improving confidence. Written communication expresses procedural and conceptual knowledge of PsET.

Written communication expressing procedural and conceptual knowledge

Subjects in this research showed their procedural mastery. All of them could find the answer of 23×45 using area representation, although they never perceived the detail explanation about the procedure. By observing the example, they could explain the steps they did.

The pictures of rectangle and partition made by S1, S3, S7, and S9 were concerned on the comparison of numbers used as the measurement; even though they are not precise. S9 even corrected the picture made. At the beginning, S9 drew lines 20 units and 3 units at the same length, then S9 corrected it by drawing lines 20 units longer than the 3 units.

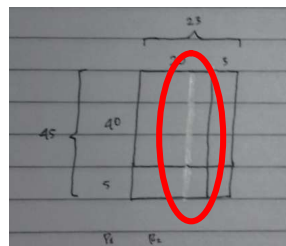


Figure 2. The Corrected Picture of S9

S2, S4, S5, S6, and S8 drew the picture without involving the consideration of the measurement. In the writing, S4 created the 40×20 rectangle area as large as the 40×3 rectangle area. In addition, there is no line separating the area of 5×20 and 5×3 . When S4 explained the things on the board, S4 separated 40 and 5 but did not make the separation line on the area shown by those numbers. This finding shows that not all teachers consider and associate the picture size with the numbers shown the real size. They just follow the example of separating tens and units of numbers then write it on the rectangle side. It reveals that pre-service teachers are lack of concerning concept related to rectangle.

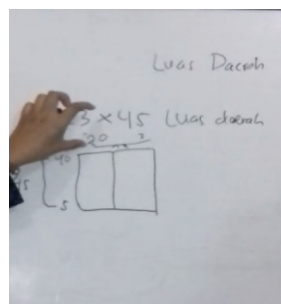


Figure 3. The Explanation on the Board by S4

S8 completed the essay on the written communication with arrows to show the multiplication process. S8 expected by looking that picture, students could follow the procedure to get the answer of the multiplication. S8 did not provide any explanation about the mathematics concept related to that representation.

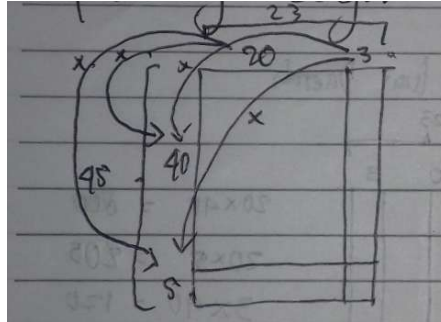


Figure 4. Arrows Made by S8

Most teachers did not involve the use of space value in its explanation, S4 did not deliver the explanation related to the separation of tens and units numbers. S7 explained clearly the explanation on the board, but S7 did not write it on the essay.

Written communication reveals the ability in constructing connection

The PsET were able to associate the representation with commutative law in numerical operation and the same rectangle area though the position was changed. In the written explanation, S7 expressed the numerical placing in the rectangle side.

Then beside and above the table, we put numbers that we will multiply. Beside the table, we put the biggest number, then on the line above the table we put the small multiplication number, for instance 23. Why 23? Because when we compare 23 with 45, the smallest number is 23.

S7 did not give any reason why the smaller number was put above the rectangle side and the bigger number beside the rectangle. The researcher explored the understanding of S7 through this interview below.

R : What if we put 40 and 5 above the table, and 20 and 3 beside it. Is the result still same?

S7 : Yes, Ma'am.

R : Why?

S7 : Because the number that is multiplied... (thinking) has the same number, tens with tens multiplication

That sample of interview shows that S7 knew that the result of multiplication remained the same though the position was changed. The reason delivered by S7 was not associated with the commutative numerical operation. This similar answer was also delivered by S1, S2, S3, S4, S5, and S8. S6 and S9 were not really sure about their answer. They even asked to try that multiplication. After the result was gained, the subjects were requested to explain why the result remained the same, yet they admitted that they felt confused. The PsET knew the commutative operation law which is $a \times b = b \times a$

$\times a$, so it means $23 \times 45 = 45 \times 23$. When they were showed multiplication using arearepresentation, they cannot construct connection with commutative operation law. They did not associate the multiplication representation 23×45 using the area of rectangle with $23 \times 45 = 45 \times 23$.

In written explanation, S9 associated the multiplication representation with the rectangle area concept. S9 distinguished it into two parts, those are a and b . To finding the area, the subject used the rectangle area formula, that is width \times height. After that the area of part a and b were sum up to get the final result.

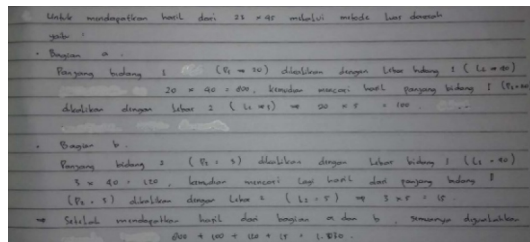


Figure 5. The Written Explanation of S9

From the interview, it was revealed that S9 did not really understand the connection of 23×45 and the rectangle area which represented it. S9 only followed the example given. Here is the sample of interview.

R : Do we really need to separate it? (showing part a and b)

S9 : For me, the picture is like that (showing the example)

R : So you just did it based on the example?

S9 : I guess so, Ma'am.

S9 did not relate the process in finding the result of 23×45 by the step in which S9 added the small rectangle areas so it became a big rectangle that has height 45 units and width 23 units.

Written Communication Improves the Confidence

The interval time when the research subjects wrote the explanation about multiplication representation on the piece of paper with explaining the representation on the board was a week. This condition made the subject could still remember what they had written on the paper and could explain it on the board fluently without seeing their notes.

The different thing was showed by S8. The subject asked permission to see the note while explaining the note on the board. S8 seemed more confident if he could see what it is written before and got the inspiration from the note.

CONCLUSIONS

The findings in this research show that written communication could reveal three things at least; they are 1) procedural and conceptual knowledge of PsET, 2) ability in constructing connection of PsET, and 3) improving the confidence of PsET. This written communication makes PsET try to

understand representation and explain it orally as much as they can, without feeling embarrassed or pressured (Kostos & Shin, 2010).

PsET tend to explain multiplication procedurally rather than conceptually. They could show how to multiply 23×45 using area representation, but they cannot really explain the representation itself. It is congruent as the opinion of (Southwell & Penglase, 2005) that states that pre-service teachers are able to do algorithm but cannot explain why that algorithm works. This lack according to (Whitacre & Nickerson, 2016) is occurred because of the lack learning experience of teachers. The limited time in learning process at school cannot give a chance for PsET to deliver their opinion. As a matter of fact, this written communication can solve this problem. PsET could deliver their explanation in written at the same time and the lecturer could check the written to get any information about everything that needs to be improved from the PsET.

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