

Think-talk-write Strategy to Develop Fifth Grade Students' Mathematical Communication Ability in Comparison

Vira Pratiwi¹ dan Dindin Abdul Muiz Lidinillah²

Universitas Pendidikan Indonesia

virapratiwi@student.upi.edu¹, dindin_a_muiz@upi.edu²

This Didactical Design Research which motivated by the curiosity of researchers towards the students' obstacles in communicating mathematical thinking within oral and written. Students' mathematical communication is one of the demands in curriculum. Communication skill should be the first one for students. This research aimed developed didactical design about students' mathematical communication by using think-talk-write strategy. This research involved mathematic and language lecturers, university students, primary school teacher, and primary school students. In this research the topic was about comparison at fifth grade with theme life in harmony'. This research resulted in didactical design of mathematical communication which could overcome fifth grade students' learning obstacle in comparison.

Keyword: didactical design, didactical design research, mathematical communication, mathematical comparison.

Based on the "21st Century Learning Partnership Framework" (BNSP 2010, pp. 44), there are some competencies or skills that must be possessed by human resources 21st century, one of the competencies that must be mastered by the people is ability to communicate and work together (communication and collaboration Skills).

Communicating be one of the skills that must be possessed by the 21st century for human resources, It is expected that the 21st century human resources able to communicate and collaborate effectively with all parties in the global interaction.

Communication in the learning of mathematics was known as mathematical communication. Communication skills are one of the competencies contained in the curriculum. For example basic competence for fifth grade students was on the theme of events in life. A complete basic competencies 4.1 restate the sentence itself, stating the sentence math, and select a sentence precise mathematical in solving problems related to the concept of comparison, the scale and the relationship between the quantity associated with everyday activities at home, school, or playground as well as checking the truth.

Before being able to communicate in written form, students must understand the concept of the material. Then they understand the concepts acquired through the thinking process of the student in learning. Once you understand the concept, students are able to communicate ideas to others. Therefore the learning is able to pack all the activity of thinking and communicating the results of their thinking. Basic competence is reached when the indicator below can be controlled by students, that is:

1. Able to express the concept of comparative into mathematical form of the sentence.
2. Capable of stating the problem in the form of comparisons to mathematical sentence.
3. Be able to communicate about the completion of the comparison.
4. Able to communicate the results of the settlement of a matter of comparison in the form of journal writing.
5. Able to give an opinion on his strategies used in solving the comparison.

Mathematical communication barriers experienced by students of Fifth grade students at SDN Galunggung and SDN Cibeureum II in Tasikmalaya that students have not been able to compile and link their mathematical thinking through communication; communicate their mathematical thinking logically and clearly to his friends and teachers, analyze and assess thinking mathematics and strategies used by other people. Results of preliminary studies, detailed as follows:

1. 83.11% of students can express and illustrate mathematical ideas into mathematical form of the sentence.
2. 24, 13% of students can communicate about the settlement comparison.
3. 26, 32% of students can communicate the results of the settlement of a matter of comparison in the form of a journal.
4. 34, 21% give an opinion on his strategies used in solving the comparison.

Overall the students have not met the minimum completeness 80% of the total. According to Gagne (in Sanjaya, 2013, pp. 66) "External factors of student learning comes from outside the individual students themselves, namely with regard to the provision of environmental conditions or designed so that students learn". Thus the need to design learning designed to improve students' mathematical communication with appropriate learning strategies through research to be conducted. So the researchers think talk of lifting the title write strategy for the development of students' mathematical communication skills in comparative material in fifth grade elementary school. Specifically, we propose the following issues:

1. How to design a didactic development of mathematical communication that can overcome the barriers of communication in fifth grade elementary school in material comparisons?
2. How the implementation of a didactic design development of mathematical communication in fifth grade elementary school in material comparisons?

This research aimed to develop a didactic design communication students' mathematical development by using a strategy talk think write (TTW). In addition to the general objectives, specific objectives of this study are as follows:

1. Develop mathematical communication didactic design that can overcome communication barriers mathematical fifth grade students of elementary school material comparisons.
2. Know the implementation of didactic development of mathematical communication design students of fifth grade elementary school material comparisons.

LITERATURE AND FRAMEWORK FOR THINKING

Mathematically Communication Students

Mathematical communication is one important part of the learning of mathematics. In fact, mathematical communication is not only important in the learning of mathematics, but also in the entire study. This is justified by Wichelt & Kearney (2009, pp.6) which states that:

"Communication is not just vital for the mathematics classroom, but in all classrooms. All educators know the importance of being Able to communicate with students, to have students communicate with one another, and to have students understand what they are communicating about".

Mathematical communication is the ability to express mathematical ideas both orally and in writing. Mathematical communication is the ability or the student's skills in expressing ideas or mathematical ideas and interprets them in writing in solving the problem "(NCTM in E Reilly, 2007, pp. 23). The main objective was to ensure that students' mathematical

communications are able to communicate accurately precise, systematic and efficient trained through math, is expected to become a habit of the students in their everyday lives. Students' mathematical communication skills can be developed through various means. Janvier (Nisa, 2012, p. 15) suggests one form to improve communication skills, which provide greater opportunities for learners to develop and integrate communication skills through a variety of external representation, such as verbal descriptions, graphics (visual), and table games formula.

Thus, NCTM (2000, p. 63) to establish the importance of communication in primary school mathematics instruction should provide an opportunity for students to:

- a. Compile and link their mathematical thinking through communication.
- b. Communicate their mathematical thinking logically and clearly to his friends, teachers, and others.
- c. Analyze and assess the mathematical thinking and strategies used by other people.
- d. Using the language of mathematics to express mathematical ideas correctly.

Think Talk Write Strategy

This strategy was introduced by Huinker and Laughlin (in Wahidah and Yuwono, 2013, pp. 14) it is basically built through activities such as think, talk, and writes ". The flowing strategy starts from the involvement of students in thinking or talking to himself after the reading process, then speak and share ideas (*sharing*) with his friend before writing.

The first phase is the thinking (*think*). There are three basic views about thinking, namely (1) thinking is cognitive, that arise internally in mind but can be estimated from the behavior, (2) thinking is a process that involves some manipulation of knowledge in cognitive systems, and (3) thinking directed and result in behavior that is directed at solving the problem or the solution.

The next step is to talk (*talk*). At this stage students will communicate using words and language that they understand. Phase communication (*talk*) on the strategy aims to enable students to skillfully speak or express opinions. A discussion or dialogue happens in groups of 3-5 students in each group. This activity can help solve a math problem because students are given the opportunity to discuss and exchange ideas to find a solution of mathematical problem solving.

Lastly is the act of writing. In general, Sipka (in Mahmudi, 2009, pp. 2) states that: "Writing can be categorized as a write informal and formal writing". Informal writing e.g. notes in class; autobiographic mathematics; journaling; and a letter. While the category of formal writing are: proof, resume journals, articles, research proposals, and modules. Informal writing focuses more on the idea of writing the truth. While in formal writing, but the truth of ideas, the quality of writing is also considered. Write strategy in this phase the students will write informally in the form of a journal. Journal contains about students' writing as a form of reflection of learning outcomes. Journal also is an effort to make the students write unconsciously.

The role of teachers in the effective use of learning strategies Think Talk Write Yamin and Ansari (in Kurniasih, 2009, pp. 50) is as follows:

1. Asking questions and tasks that bring engagement and challenge each student to think.
2. Listen to students' ideas carefully.
3. Asking the students to express ideas orally and in writing.
4. Decide what is dug up and brought into the discussion.
5. Decide when to give information, clarify issues, using the model, guide and let students struggling in trouble.

6. Monitor and assess students' participation in the discussion and decide when and how to encourage each student to take part.

Talk think write current strategy implementation comes with a few other teaching methods, including, among others; lectures, discussions, question and answer, and others. Collaboration between methods are aimed at making the strategy think talk as write a unity that a whole to set up a learning path from thinking activity, speaking and writing.

RESEARCH METHODS

The method used in this research is the dactic design. Research didactic design (didactical Design Research) is the development of educational methods research design (EDR. Plomp (2007, pp. 9), states a research design:

A systematic reviews of designing, developing and evaluating educational interventions (such as programs, strategies and learning materials, products and systems) solutions to solve complex problems in educational practice, which also aims to advance our knowledge of the characteristics of the interventions as well as process design and development.

Didactical research stage design research conducted by the decline of the stages of research design research model of Reeves.

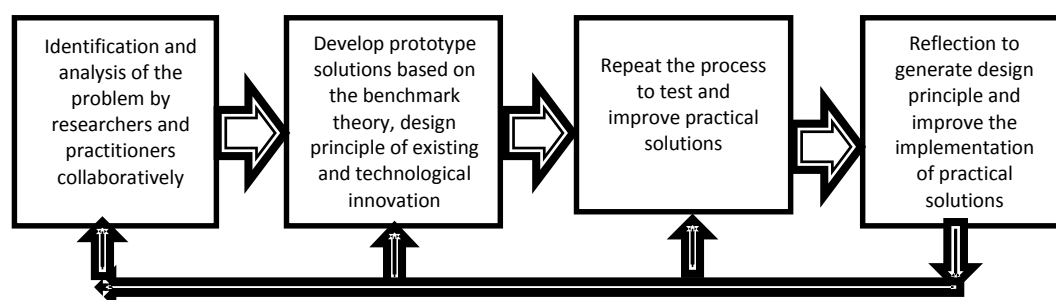


Figure 1 The steps of designing Research Reeves Model

This study analyzes the learning process before-until post metapedadidaktik learning with *learning* and attention Hypothetical trajectory (HLT) as a first step in preparing instructional design. Metapedadidaktik is way of thinking teachers to learning activities. According to Suryadi (2012, pp. 5) metapedadidaktik a teacher's ability to, look at the components of the modified triangle didactic namely ADP, HD, and HP as a whole. In addition, develop measures so as to create didactic and pedagogical situations which correspond to the needs of students. Next, identify and analyze the response of the students as a result of acts performed didactic and pedagogical. Important part is to take a didactic or pedagogical advanced response analysis based on the results of students towards the achievement of learning targets. While hypothetical learning trajectory (HLT) is suggestive trajectory of student learning. The assumption is studied further by the day during the study based on the plan in the form of learning activities "(Gravemeijer the Princess, 2012, pp. 2). Researchers conducted the study of theory and create learning tracks that serve as preliminary design. The components of Hypothetical learning trajectory consist of learning goals for students, plan learning activities, and allegations of the learning process in the classroom.

The design of this study can be described as follows:

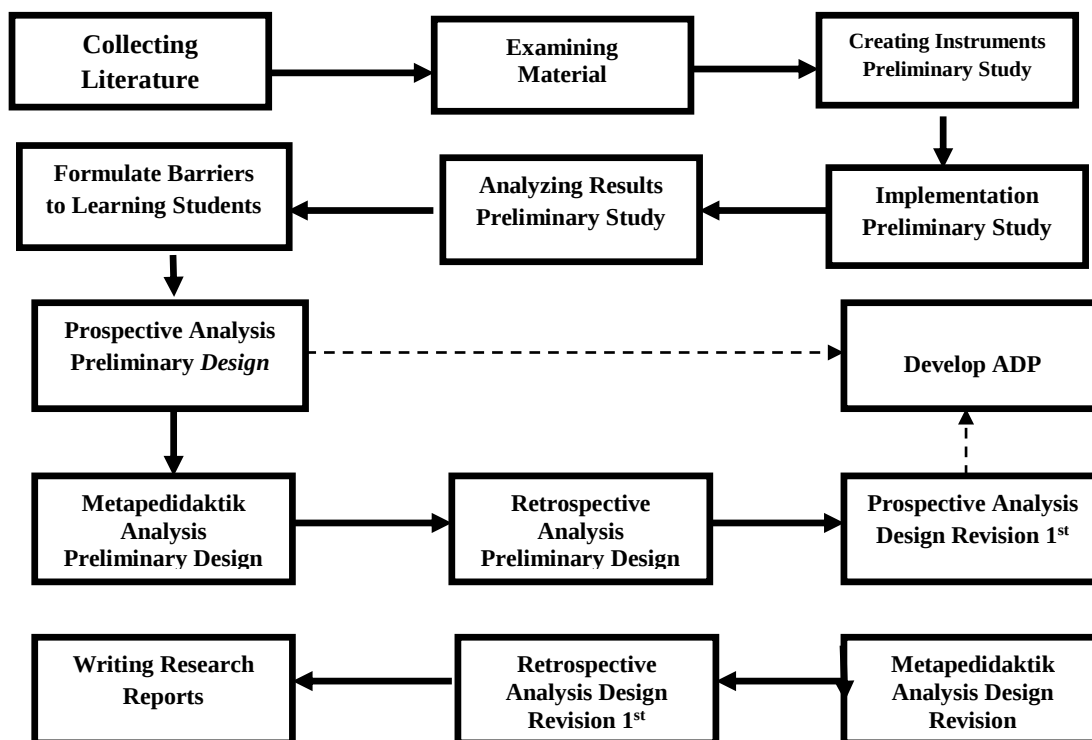


Figure 2 Chart of Design Research *Didactical Design Research (DDR)*

Research conducted at SDN Galunggung located on Jl. Galunggung No. 14 district. Tawang and SDN Cibeureum 2 at Jl. KH Khoer Affandi 62 Ex New Town district. Cibeureum Tasikmalaya. In qualitative research, the researcher is the main instrument, once the focus of the research is clear, then developed into a research instrument simpler to complete data needed by researchers. According Sugiyono (2012, pp. 306) "the researcher as a human instrument, serves to fix the focus of research, selecting informants as a source of data, interpret the data and make conclusions on its findings". Instruments that support this research were observation sheets, sheets interview questionnaire responses of students to make observations, interviews and determine a student's response after test design. The research instrument was developed to test the validity and reliability of research instruments. Test data validity in qualitative research was consisted of testing credibility, dependability, and conformability (Sugiyono, 2012: 270-277). In this study, researchers refer to the opinion of Miles and Huberman (Sugiono, 2012: 337) activity in qualitative data analysis performed interactively and runs continuously until complete so that the data is already saturated.

FINDINGS AND DISCUSSION

Finding

In the previous findings have obtained the data communication barriers students namely, type 1: barriers to communicating the completion of a matter of comparison, type 2: the obstacles communicate measures do problem comparisons through writing and type 3: barriers to communicate an opinion on the strategy used friends in solving comparison,

Examples of student answers:

INSTRUMEN STUDI PENDAHULUAN STRATEGI THINK TALK WRITE UNTUK PENGEMBANGAN KEMAMPUAN KOMUNIKASI MATEMATIS SISWA PADA MATERI PERBANDINGAN DAN SKALA		INSTRUMEN STUDI PENDAHULUAN STRATEGI THINK TALK WRITE UNTUK PENGEMBANGAN KEMAMPUAN KOMUNIKASI MATEMATIS SISWA PADA MATERI PERBANDINGAN DAN SKALA	
Nama Siswa	: M. FIKRI	Nama Siswa	: A. S. I. B. S. K. A. A.
Kelas	: 5C	Kelas	: 5C
Asal Sekolah	: SDN Galuragung	Asal Sekolah	: SDN Galuragung 2
Hari/Tanggal	: 29.04.2015	Hari/Tanggal	: Rabu 16.11.2015
Baca secara seksama soal di bawah ini ! 1. Edo membantu ibu membersihkan halaman dan menyiram pot-pot tanaman. Pot tanaman milik ibu ada yang berukuran besar, sedang dan kecil. Perbandingan jumlah pot besar dan pot sedang adalah 7 : 5. Sedangkan perbandingan jumlah pot sedang dan pot kecil adalah 3 : 2. Jika diketahui jumlah pot kecil ada 30, maka berapakah jumlah pot besar milik ibu? Untuk mengerjakan soal di atas, jawab pertanyaan di bawah ini! a. Berapa perbandingan jumlah pot besar dan pot sedang? <u>7 : 5</u> b. Berapa perbandingan jumlah pot sedang dan pot kecil? <u>3 : 2</u> c. Apa yang ditanyakan pada soal tersebut? <u>tergantung perbandingan</u> d. Apa cara yang akan digunakan untuk mencari jumlah pot besar? <u>63</u>		Baca secara seksama soal di bawah ini ! 1. Edo membantu ibu membersihkan halaman dan menyiram pot-pot tanaman. Pot tanaman milik ibu ada yang berukuran besar dan kecil. Perbandingan jumlah pot besar dan pot kecil adalah 3 : 2. Jika diketahui jumlah pot besar dan pot kecil ada 30, maka berapakah jumlah pot besar milik ibu? Untuk mengerjakan soal di atas, jawab pertanyaan di bawah ini! a. Berapa perbandingan jumlah pot besar dan pot kecil? <u>3 : 2</u> b. Apa yang ditanyakan pada soal tersebut? <u>Jumlah pot besar dan kecil</u> c. Apa cara yang akan digunakan untuk mencari jumlah pot besar? <u>$\frac{3}{2} \times 30 = 15$ Pot kecil</u> <u>$\frac{2}{3} \times 30 = 10$ Pot besar</u>	

Figure 3 Type of Communication Barriers 1

f. Ceritakan langkah-langkah kamu mengerjakan soal di atas!	e. Ceritakan langkah-langkah kamu mengerjakan soal di atas!
<u>Dikali dengan dikali</u>	<u>Dengan cara Mengalikan Perbandingan</u>

Figure 4. Type of Communication Barriers 2

f. Simak jawaban yang dibacakan temanmu! Apakah jawaban temanmu itu sudah benar? Mengapa demikian? <u>Insuceloh / benar karena teman saya Pintar akan mengerjakan</u>	g. Simak jawaban yang dibacakan temanmu! Apakah jawaban temanmu itu sudah benar? Mengapa demikian? <u>✓</u>
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Figure 5 Type of Communication Barriers 3

Didactic Design of Mathematic Communication in Fifth Grade Elementary School in Comparison.

Once known mathematical communication barriers in the material comparison in fifth grade elementary school, then the next thing to do is to develop instructional design. Instructional design developed aim to minimize or prevent the rise of mathematical communication barriers. Development of instructional design is an attempt to learn about communication purposes is to reach mathematics. Based on KI (the core competence) and KD (the basic competence) are developed, the indicator and the learning objectives are arranged in a didactic design in this study are as follows, indicators and mathematical learning objectives communication on comparison.

Mathematical Communications indicators
1. Express concepts in the form of a sentence comparison to mathematics.
2. Express concepts in the form of mathematical sentences
3. Stating the problem in the form of a sentence comparison to mathematics.
4. Solve the problem of comparison.
5. Declare the result of the settlement of the problem in the form of comparisons to the journal.
Learning objectives

1. Able to express the concept of comparative into mathematical form of the sentence.
2. Capable of stating the problem in the form of comparisons to mathematical sentence.
3. Be able to communicate about the completion of the comparison.
4. Able to communicate the results of the settlement of a matter of comparison in the form of journal writing.
5. Able to give an opinion on his strategies used in solving the comparison.

Step-by-step learning mathematical communication activities on material ratio fifth grade by using strategy think talk write with the allocation of learning time 3x35 minutes. Below is an outline of the design development is:

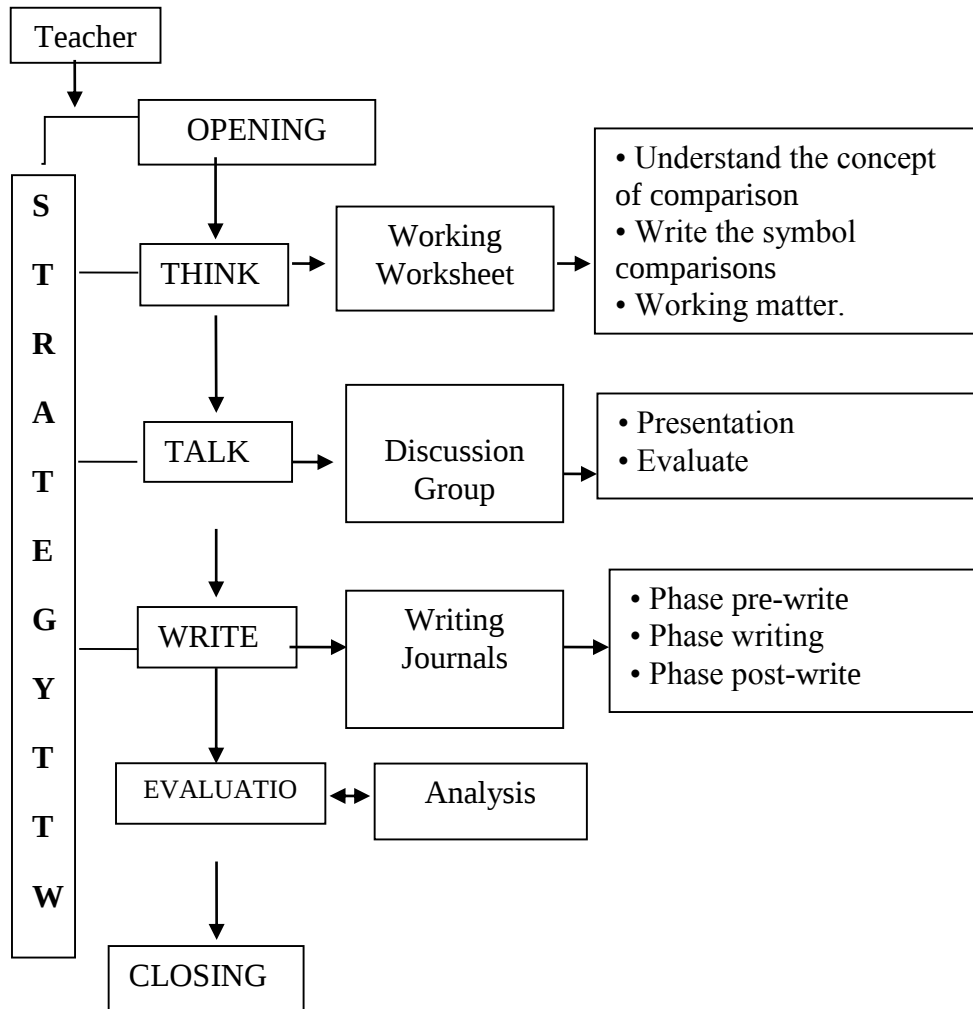


Figure 6. Schematic Design Didactic of Think Talk Write's Strategy

DISCUSSION

Development of didactic design

Initial didactic design development based on mathematical was found communication barriers when preliminary studies. The theory used in the preparation of the initial design of this include learning theory by Gagne, Piaget learned Theory, Strategy *Think Talk Write* by Huinker and mathematical communication by the NCTM standards.

Table 1 Response Prediction Students and Anticipation Didactic

Student Response Prediction	ADP
Students immediately answered after reading about not reading the steps provided.	Emphasis on the "to do the problems above, answer the question below!"
Record comparison without simplifying into the simplest form of comparison.	What is the ratio of the number of boys and girls? Can it be simplified? For figures on the left and right by the same number.
Students do not know how to find the amount of each pot is moved by the mother and Edo.	Using box strategy or strategies multiplying comparison with the total pot.
Students trouble to write process steps work on the problems of comparison.	Guiding students in accordance with the stages of writing. Pre-writing Select the topics that were written.

Didactic design learning activities using the write strategy consists think talk from three activity core. Learning strategy is built through thought, talk and writing. The first stage is pre-writing. Students will reflect on the idea of what will be a topic in his writing. Teachers lead students to write about the process of working through a comparison of some of the questions.

B. Langkah-langkah. 1. Ucapkan bismillah sebelum melakukan langkah-langkah di bawah ini! 2. Lengkapi tabel dibawah ini berdasarkan jumlah siswa di kelasmu!		
No	Keterangan	Bilangan
1.	Banyak siswa perempuan	15
2.	Banyak siswa laki-laki	20
3.	Jumlah siswa	35
4.	Selisi banyak siswa perempuan dan banyak siswa laki-laki	$20 - 15 = 5$
5.	Perbandingan banyak siswa perempuan dan banyak siswa laki-	$15 : 20 = 3 : 4$

	laki	
6.	Selisi banyak siswa perempuan dan jumlah siswa	$35 - 15 = 20$
7.	Perbandingan banyak siswa perempuan dan jumlah siswa	$15 : 35$
8.	Perbandingan banyak siswa perempuan dan jumlah siswa	$15 : 35$
9.	Perbandingan banyak siswa perempuan dan selisi banyak siswa perempuan dan laki-laki	$15 : 5$
10.	Perbandingan jumlah siswa dan selisi banyak siswa perempuan dan laki-laki	$5 : 35$

Figure 7 Example of Worksheet

After that, students recall how he is doing about the comparison on activities 4. Students are allowed to re-examine the results of its work in the worksheet activities 4.

At this stage, students gather experience learning about the comparison. Through the process of reflection, students determine that he would write about the working process of comparison.

Second stage is writing itself, students write the language of their everyday work on the problems of the comparison that has been experienced. Students are given examples of writing that tells about the process of doing the matter of comparison. So that students have a picture to tell in their own words through writing. At the end of the lesson the students will work on the evaluation of which there are about to rewrite process comparison work on the problems.

When finished completing the Worksheet of journal writing, students re-examine what has been written. Event check students' papers have been written after writing an activity stage.

Implementation of didactic designing development of mathematical communication in class V SD in a matter of comparison.

Implementation of early learning didactic design implemented in SDN Cibeureum 2, with the number of students as many as 35 people. Learning held in one meeting and consists of several activities. Activity 1st and 2nd, an activity to deepen comprehension students about the concept of comparison, writes the symbol of the comparison and its application in everyday life. Activity 3th, to train students to write any behavior that reflects unity and vice versa.

do apersepsi by asking questions; "Will you observe the mother holding a stick?" "How long is the stick?" "Which sticks longer?" "Which Sticks shorter?"	Students do classroom environment observation about the number of boys and girls in her class. (Observing) Students find out the ratio of boys and girls in her class. (Information processing)
do apersepsi by asking questions; "Will you observe the mother holding a stick?" "How long is the stick?" "Which sticks longer?" "Which Sticks shorter?"	Students do classroom environment observation about the number of boys and girls in her class. (Observing) Students find out the ratio of boys and girls in her class. (Information processing)

In addition, there are activities to write about the experience of unity and oneness ever experienced students. This activity is based on load demands social studies. Activity 4th, students work on the problems of comparison.

"Edo help mothers move potted plants from the backyard to the front yard. Potted plants were transferred mother and Edo amounted to 45 pots. Comparison of the number of pots being moved mother and Edo is 4: 5. How much of each pot is moved by the mother and Edo? " To work on the problems above, answer the question below! - What is the ratio of the number of displaced mothers pot and the pots were transferred Edo? - What was asked on the matter? - How do I find a lot of pots were transferred mother and Edo? - How many pots are transferred mother? - How many pots are moved Edo?
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To work on the problems that there are in comparison worksheets, students were led to identify things that are found in the matter, find out the problems that must be solved, and work on the problems of the strategies of each student. After the students worked, the next activity students discuss the results of their work with friends in the group.



Figure 6 students are guided to discuss the results

Activities which are carried out students are discussing out of 4-6 students. Topics to be used as ingredients in the discussion were the workmanship worksheet group. After the discussion, students write a journal about the process of working on a matter of comparison. Although students initially less monitored well, but it can be anticipated well.

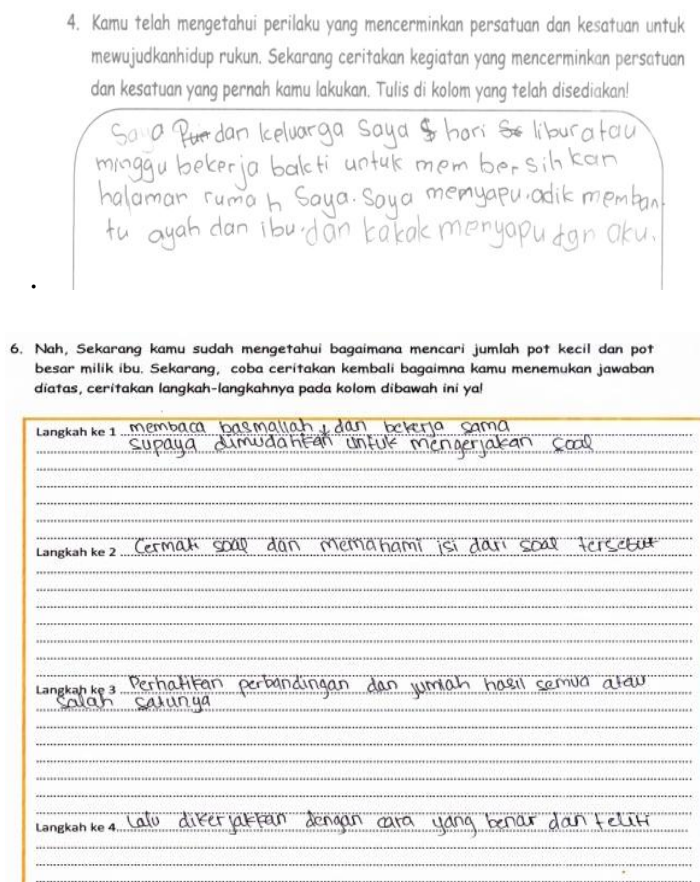


Figure 7 Example of Journal

Although the initial design implementation didactic responses are students who are not unpredictable, but it is a natural thing when you are in the learning process. From the results of the implementation of the didactic design revisions researchers get results from the development of talk-think-write strategy to improve students' mathematical communication ability on comparative material. This study design is a concept and this context is the result re-personalization based on the study of the didactic design revisions by researchers. The learning is built through thought, talk, and writing.

CONCLUSION

Didactic design early mathematical communication on the concept is based on a communication comparison's obstacles arise. Instructional design collaborates on a process developed by thinking, discussing and writing. Learning begins with the thinking, identify a problem and plan solutions math problems. Thereafter, continued learning by giving students the chance to discuss and exchange ideas. Topics to be discussed are the results of their work on the solution of mathematical problems of comparison (talk). Recently students write about the working process of comparison, to build students' ability written communication (write). After the researchers was made a hypothetical learning trajectory (HLT) to guide the researcher during the initial learning. Then, the investigators designed a scheme that can describe the design of didactic learning activities called talk think write strategy development to improved communication skills mathematical fifth grade students in the material comparison, Implementation of the initial didactic design implemented in fifth grade elementary school of

SDN Cibeureum II by the number of students 35 people. The results of the initial didactic design implementation largely as predicted responses of students, students' writing skills are still lacking, it was found that responses are not predictable in advance.

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