Lesson study on 2\textsuperscript{nd} grader of elementary school to improve the student’s numeracy skill

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Abstract. The purpose of this research is to find the most appropriate learning media of multiplication and division for the 2nd graders of elementary school. The study used the steps in the lesson study, Plan-Do-See. Data were taken using observation instruments, video documentation, and learning evaluation tools. Initially, teachers used gravel as media of multiplication and division. Students can solve numeracy problems when they learn by those media. In test, 80\% of students were failure when the teacher evaluates them. By involving experts and partner teachers at school, classroom teachers can solve problems by discover multiplication and division media with the drawing media created by the students themselves. At the end of the lesson, 100\% of students have mastered multiplication and division with the media.

1. Introduction

State Elementary School 1 Rempek is located in North Lombok District, West Nusa Tenggara, Indonesia. The school is located 45 minutes from downtown. The school environment is an agrarian area for agriculture and plantation. Although in the village, but the awareness of the community to send the students to school in the area is very high. In Rempek village, there are 2 public elementary schools and 1 private elementary school. Grade 2 students in 3 schools are on average 25 to 35 students.

In grade 2 mathematics learning, State Elementary School 1 Rempek teacher uses the student book of 2013 curriculum. Mathematics learning fuses in certain themes. Multiplication and division melt into the theme of ‘studying in my environment’. In its implementation, teachers have implemented cooperative learning. The class table at State Elementary School 1 Rempek has been laid out so that 1 group consists of 6 students as shown in Figure 1.

Figure 1. The class condition of State Elementary School 1 Rempek

Studying groups actually encourages students to communicate with each other. In group learning, there are several principles that must be met, that are student got: (a) a supportive effect in the
cooperative case; (B) an obstructive effect in the competitive case; and (c) a neutral effect in the individualistic case on the other students [1].

Teachers also have a role in interaction among students. There are only three major choices of interaction among students. Students can compete with each trying to do better than the other students in the class; students can work individually toward set criteria; or students can work cooperatively taking responsibility for each other’s learning as well as their own. While traditional teaching has strongly encouraged students to work alone, competing with each other, the research on how students learn best goes in the opposite direction [2]. In State Elementary School 1 Rempek, teachers have also been actively encouraging student interaction related to learning. With the fact that Teachers have applied cooperative learning, and participated in learning, students should be able to receive multiplication and division materials easily. In fact, the students still have not succeeded in completing the multiplication and division.

It is actually closely related to the cognitive development of students. The development of cognitive students consists of 3 dominant aspects. Such differences were sought in: existing knowledge about the problems, ability to acquire new information about them, and process-level differences underlying developmental changes in the first two areas [3]. The fact that happened to the 2nd grader of State Elementary School 1 Rempek, the comprehension aspect of multiplication material has been fulfilled. This is shown by the success of students in solving multiplication and division problems by using gravel. However, when students are given multiplication tests, it was no more than 20% students can solve the problem. This means, aspects of building new knowledge, are not met [3].

The problem lies not in memory. Memory has no impact on understanding [4]. The teacher suspects that the problem was caused by learning media. The learning medium used was concrete, while the test was an abstract. In the stage of cognitive development, the pattern of development jumps from enactive to symbolic [5]. Iconic stage is principally governed by principles of perceptual organization. The iconic stage can be both completing and extrapolating [5].

Up to this point, the teacher has understood that there was a problem in the learning phase of the student. However, teachers find it difficult to translate the meaning of the iconic learning phase in the classroom. This requires collaboration with colleagues. Of course, this collaboration requires coordination with school facilitators and expert teams as resource persons. Collaborative activities involving colleagues, principals, and teams of experts are called lesson studies.

Lesson study (LS) is an activity that supports professional development of teacher [6]. Lesson study consists of 3 major activities, namely: PLAN, DO, and SEE. Each has a specific purpose. Plan aims to prepare the learning activities as well as possible. In the activity of PLAN, teachers are allowed to pilot the learning preparation on limited students. The step of DO aims to see the successful of learning plan. In activities of DO, observers can also observe which students are not learning. The step of SEE aims to discuss findings during the execution of learning. See can also be used to formulate recommendations on observer findings by facilitators. In LS activities, there is no activity to criticize the teacher plan and its actions. All observations are student-centered.

Although this activity is focused on teacher models, lesson study promises of improved student learning and sustained teacher growth [7]. LS open opportunities for discussion on improvements in learning. With input from related colleagues on learning, teachers will get information on what should be done in the next lesson. Students will also increase their understanding. Thus, teachers will have a solution to their learning problems in the classroom.

2. Theoretical Basis

2.1. Cognitive Growth

School is a place to learn and gain experience. One of the goals of school is to teach students to understand the world, including their self. Toward this aims, the school function organized around three goals: (a) transmission of knowledge based on its culture-valued; (b) development of learning skills; and (c) motivate student to increase their creative thinking. These three goals are the objects of
cognitive growth study [8]. Schools are also an appropriate ways for teachers to develop new teaching methods and strengthen math materials [9].

At school, the main constituent elements are students and teachers. Without either of them, the school has no meaning. Of the two elements, the student is one of the most interesting to discuss. Of all levels of students, elementary students are the most varied. In primary school, teachers will invite students to learn from the very basic level, i.e. reading and writing, to the level of problem solving. Especially in grade 2 students, at this age, the thinking stage of students is identifying, describing, and extending patterns. In numbers, students of this age are expected to understand the concept of equality by partitioning whole numbers in a variety of ways, e.g. 5 equals 1 + 4, 2 + 3 and others [10].

The role of the teacher at the stage of development is to ensure that the stages are passed by the students happily. Students, who learn happily, are more receptive to lessons. Students of that age will learn happily if they discover new things, or use new methods that fit with their stage of thinking.

2.2. Lesson Study
Lesson Study (LS) exists to help create common expectations amongst the LS group members. In doing this, it will help the group to form a good working relationship that helps members to share ideas, concerns, challenges and ‘wonderings’ without fear of criticism. All this was aided the sharing and discovery of new practice knowledge.

At all stages in this Lesson Study we act according to the following: (1) All members of the LS group were equal as learners whatever their age, experience, expertise or seniority in school (or beyond); (2) All contributions were treated with unconditional positive regard; (3) it supported whoever teaches the research lesson(s) and make faithful observations, recording as much as possible what pupils say as well as do; (4) We used common tools for Lesson Study – planners, pupil interview prompts and approaches to sharing outcomes with each other; (5) it used pupils’ work and interview comments to inform the post lesson discussion alongside our observations; (6) it used the post lesson discussion flow (Figure 2); (7) it shared the aims and outcomes of our Lesson Study with our pupils appropriately, depending on their ages and stages of development. Their views, ideas and perspectives was being treated with equal positive regard [11].

![Figure 2. Flowchart of the Lesson Study. The diagram has involved students as a source of reference (figure from [11]).](image)

In Figure 2, LS activities have involved students as referral sources. Results of interviews with students can be used as discussion materials. This will reinforce the validity of the lesson study recommendations. In this research, LS is done on 1 cycle with optimal planning.

2.3. Investigating Learning Problem
The problem of learning, according to psychological theory, revolves around the interaction of teachers and students, the motivation of learning and teaching, and interest in the objects studied [9]. Following the previous research, we developed problem-finding issues ranging from those and completed with student aspirations. We see that learning problems can come from teachers (teaching methods, learning media, lesson plan) or students (aspirations).
We begin to identify problems by getting teachers to analysing videos of learning, analysing cases, observing and analysing student work, and identifying student aspirations. Of the 4 activities, teachers will produce various problems in the classroom. The problem-reduction process is based on: (a) whether the problem often arises; (B) whether the problem was experienced by most students; and (c) whether the problem can be solved by the teacher. The teacher then constructs a priority scale to solve one of the many learning problems revealed. In this research, the problem of learning was the lack of multiplication and the division numerical skills of 2nd grade students of State Elementary School 1 Rempek.

3. Methods
This study uses a modified lesson study. Modifications were made due to limited implementation time. This activity was held from February to May 2017. The LS was conducted in 1 stage, and involves 6 people in 1 team. 1 person acted as model teacher, 1 facilitator, 1 person as resource, and 3 people as observer.

4. Result and Discussion
This activity was carried out in 3 stages, namely: PLAN, DO, and SEE. PLAN activities aim to find learning problems; conjecture the solutions; and prepare lesson plan. DO activities were aimed to identify which students were not learning, analysing the causes, and finding solutions. SEE activity was a reflection of learning outcomes. SEE was intended to discuss the best solution of student learning problems [12].

4.1. Plan
There are 2 activities in the implementation of PLAN. In stage 1, PLAN begins with the activity of finding the problem. At the beginning of the activity, the teacher identifies some of the common learning problems. Some of the problems that arise are: (a) students cannot solve the contextual problem; (B) students didn’t brave to ask a question; and (c) the student cannot complete the multiplication and division test.

Three problems were then selected based on specific criteria. The selection was aimed for focusing the teacher's actions to the problem. Based on the criteria, the teacher then chose multiplication and division issues. However, the problems faced by teachers were not simple. In school learning, teachers have implemented student centered learning. Teachers have been using various teaching aids in learning. The media used were all realistic, such as gravel, wood, and various objects around the students. At the time of teaching, the teacher stated that students can follow the learning well. Students can solve problems using gravel media. However, when student were given formative tests without the use of media, only 20% of students can solve the problems.

In school, teachers have tried to solve the problem by increasing the number of exercise. However, the action has not worked. Teachers do not realize that there was a jump in the way students thinks. The thinking process jumps from a concrete object (gravel) to an abstract object (multiplication and division problem). Student thinking processes should be gradual so that students didn’t feel difficult accepting new things [13]. In this case the teacher skipped the semi-concrete process.

The next problem was how to interpret and implement the 'semi-concrete process'. At first the teacher interpreted the 'semi-concrete process' by drawing the animals. Multiplication 3x4 interpreted by counting the number of feet in the picture of 3 cows. In the simulation to some students, it was concluded that interpreting 3x4 by drawing 3 cows was less precise. There is a difference between teacher expectation and student's interpretation on the problem. The teacher hopes that the resulting image was a sketch. However, students do not want to draw a sketch. They determined that the resulting image should be good, as shown in Figure 3 (b).
Figure 3. Figure 1(a) shows the expected cow sketch of the teacher, while 1(b) shows the student's interpretation of the multiplication problem given by the teacher.

This activity made the time of lesson became long. The resulting image, which was easy to create by student [14], was not achieved. The solution that have been found, cause another problems. This means, the solution was less than perfect. In the lesson, Teachers need to improve the media used or the way they give instruction.

Based on the experience, the teacher then redesigned the media. The teacher removed the cow's image instructions and replaces them with gravel as shown in Figure 4. The instruction reduced the lesson time by more than 60%. At this stage, the teacher was ready with the media to be used to solve the learning problems.

Figure 4. The teacher instruction on media for multiplication and division. The teacher has simplified the image form that the student will produce.

The second stage of the PLAN activities was developing learning tools and observation instruments. At this stage, the teacher has to choice an action. First, the teacher teaches multiplication and division with its media, fulltime lesson. Second, teachers plan to familiarize multiplication and division every 15 minutes at the end of math lesson. Teacher then choose second option. The teacher also composes several notes in habituation, those are: (1) in each action, the teacher focuses on one between multiplication and division; (2) on each week, the teacher provides a test process; and (3) the action begins with a pre-test and ends with a post-test.

In the final stages of PLAN, teachers compile observation sheets for observers. Similar with other lesson studies, this observation sheet was used as a tool to saw which students were not learning [15].

4.2. Do
DO activity was held on April 16, 2017. The activity was held on the first and second hours at State Elementary School 1 Rempek, North Lombok regency. Observer in the activity was the class teacher comes from the elementary school. Observer of open class activities was 3 people.

Before the opening of the classroom, the principal as a facilitator holds a briefing. Briefing was intended to provide brief information to observers who didn’t follow the PLAN. In the briefing, Mrs. Asih, who played the role of teacher model, conveyed the lesson plan using the drawing media made by the students themselves. No discussion in briefing activities.

4.3. See
After the lesson, the principal leads the SEE activities. This activity was intended to discuss the learning process. SEE begun with a reflection of the model teacher. This reflection aims to give the teacher an opportunity to explain the appropriateness of the plan with the implementation of the lesson. In these activities the teacher realizes that there were some things that were beyond estimation.
In Lesson Plan, the teacher plans not to provide explanations of multiplication with the image media. Teachers wish that students find their own method with the help of worksheets. In fact, more than half of the 36 students in the class asked the same question. This resulted in the incompatibility of implementation time with the lesson plan.

Based on the observations, the things teachers do were: (1) implementing lessons based on previous relevant assessments; (2) informing the students about what and how the assessment will be done; (3) exploring the student's prior knowledge before beginning the lesson; (4) walking around the classroom to observe how students were doing learning activities; (5) inviting students to discuss individually about their learning activities; (6) providing verbal or written feedback to students about their achievements and how to improve them; (7) using assessment techniques to determine whether the students' understanding is in accordance with the minimum competency set.

The interesting thing that teachers felt was the experience of finding new methods in learning. The experience didn’t appear suddenly, but through the process of discovering. Experience finding new ways of previous experience was what causes teachers felt happy [16]. In addition, the teacher also senses that her students were becoming cleverer in calculating multiplication and division.

However, teachers cannot be said to be satisfied, because the desired average grade has not been achieved. Of course this was a challenge because with the number of students that much in one class, it was not easy to do formative assessment to reach the goal of habituation. If there was an opportunity to improve, of course the teacher will prepare tiered numbers, which corresponds to the level of student ability. Currently, the problems in LK students were similar for all students, so it was not challenging for clever students.

Beside discuss with teachers and observers, we conducted interviews with several students. There were some students interviewed, they were R, B, G1, G2, T, H, Z, D, and some daughters who shily mentioned his name. In the interview, all of them were happy with the drawing method to learn multiplication and division. Almost all say that the division becomes easier.

For grade 2 students, the concept of division is not easy, since almost all books say that division is a repeating reduction. For grade 2 students, it is not easy to say 'how many times reduce' as the concept of division. With drawing techniques, students are expected to achieve the desired level. I then tried to give the test to the student (Figure 3). The result, one of the students, can solve the problem with drawing technique, although it takes a little longer time. My guess was that the student is in moderate level. Figure 5 shows the spontaneous answers of students.

![Figure 5](image.png)

**Figure 5.** Spontaneous answers from students, G1, when asked what is 15: 3. The answer was obtained by G1 by drawing 15 small spheres. He then grouped the sphere into a container containing three spheres. He then calculates the number of containers, obtained the result `5: 3 is 5.

Unsatisfied with student test results, the teacher repeats the lesson, with some improvements. In limited classroom activities along with 1 observer, the teacher also provides multiplication and division tests. The final test results show outstanding student performance. 100% of students have scored 100 on multiplication and division tests.

In addition to good test results, the teacher also conveyed that cooperative learning for the 2nd graders was running well. However, the number of students in one group should be considered. During this time, in State Elementary School 1 Rempek, the table in the classroom has been arranged so that 1
group consists of 6 students. In fact, the students actually get longer while working with groups of 6 people. According to the teacher, students will be faster if working in pairs.

Based on the above explanation, it is clear that the implementation of LS in State Elementary School 1 Rempek has been in accordance with the stages. Planning activities were followed by all teams and were known by facilitators, open-class activities were also followed by teams, there were interviews with students, and there were discussions to bring out activity recommendations. The final step was to disseminate the findings to all teachers in the Rempek group, North Lombok.

5. Conclusion
From the above study, it was concluded that the implementation of LS in State Elementary School 1 Rempek succeeded. The indications were: (1) all grade 2 students earn 100 on multiplication and distribution; (2) the teacher succeeds in finding new methods for teaching multiplication and sharing, based on input from colleagues and expert teams; and (3) the whole implementing team was happy to carry out this activity.

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References
[1] Li M and Lam B 2013 The Active Classroom (Hongkong: Hong Kong Institute Educ)
[2] Johnson R and Johnson D 1986 Sci child 24 1
[3] Siegler R 1976 Cogn psycchol 8 481
[4] Hong G and Raudenbush S 2005 Educ Eval Policy Anal 27 205
[5] Bruner J 1966 Toward a theory of instruction (London: Harvard University Press)
[6] Inprasitha M, Isoda M, Wang P, and Yeap B 2015 LESSON STUDY: Chall Math Educ 12 121
[7] Ebaeguin M, Stephens M 2015 7th ICMI-East Asia reg conf math educ (Philippines: Cebu City)
[8] Demetriou A, Shayer M, Efklides A 2016 Neo-Piagetian theories of cognitive development: Implications and applications for education (Abingdon: Routledge)
[9] Schneider B, Krajci J, Lavonen J, Salmela-Aro K, Broda M, Spicer J, Bruner J, Moeller J, Linnansaari J, Juuti K, Viljaranta J 2016 J Res Sci Teach 53 400
[10] Doyle W 1988 Educ Psychol 23 167
[11] Dudley P 2014 Lesson Study: a handbook (Cambridge: Cambridge)
[12] Lewis C, Perry R, Murata A 2006 Educ res 35 3
[13] Bruner, J 1964 Am psychol 19 1
[14] Arindiono R, Ramadhani N 2013 J Sains dan Seni ITS 2 F28
[15] Akiba M, Wilkinson B 2016 J Teach Educ 67 74
[16] Schulz L, Bonawitz E 2007 Dev psychol 43 1045.