Development of remedial mathematics learning based on lesson study for learning community against students' problem solving analysis capabilities

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Abstract. This study aims to develop remedial mathematics learning tools based on Lesson Study for Learning Community (LSLC). This research uses a mixed method that combines two previous forms of research, namely research and development and experimental research. The subjects of the research were grade VII students. This type of research is a step of research by combining two forms of research that have been there before, namely the development of research and experimental research. The learning instruments developed in this study were on the material for the addition and subtraction of integer in grade VII SMP including Learning Implementation Plan, Student Worksheet, and Learning Outcomes Test. After obtaining a valid, practical, and effective device, the device is then tested in the experimental class to find out whether there is an effect on students problem solving abilities. homogeneity test shows the value of sigh. 0.671 on the pre test and 0.450 in the post test so that it can be concluded that the assumption of homogeneity of variance is fulfilled. Based on the results of the validity, effectiveness, and practicality test, the researcher concluded that the learning platform through bridge games and Lesson Study for Learning Community (LSLC) is a valid, effective, and practical device. At the time of the field trial research was also carried out. From the results of the test differences in problem solving in the two classes using the Mann Whitney Test shows the value of sighing. 0.000 (p<0.05), so it can be concluded that there are differences in problem solving between the control class using conventional instruction and the experimental class using Lesson Study for Learning Community (LSLC) based remedial learning with significant results so that when compared with conventional methods this device gets higher results than in students who use conventional methods.

1. Introduction
The quality of the nation's life is very much determined by education. Education is an activity that prepares students to be able to deal with changing circumstances in life and an ever evolving world [1],[19]. One of the institutions that facilitate education is the school. A good teaching and learning process strived to produce good changes for students in conducting teaching and learning activities that can achieve the goals set is not easy. Therefore we need the most effective and efficient teaching and learning strategy. Learning is a process of interaction between teacher and students [3]. The learning component includes the teacher, students, strategies, and tools used in learning [13],[16]. Teachers as educators must realize that the progress of education depends more on the dedication of the teacher and his creativity after knowing the changes that occur [19]. For this reason, teachers in organizing learning activities must be creative in choosing learning models. Many learning models can be used in learning mathematics but not every learning model can be applied to the material [5]. for this reason, there is a need for models in learning to achieve teaching objectives. The use of learning models in teaching and learning activities for certain materials must be in accordance with the topic or
subject matter that will be presented in front of the class. The use of appropriate learning models by a teacher is expected to be able to instill the concept of material properly to students and in accordance with the competencies achieved [4],[22]. One of the subject matter of mathematics for Class VII students which is loaded with the application of contextual problems and the ability to think at a higher level is comparison material [12]. Based on information carried out at SMP Negeri 1 Proppo Pamekasan, one of the mathematics subjects for Grade VII students of semester I is Comparison. In general, the difficulties faced by students in solving comparative problems, students still experience problems or difficulties in associating information that is known with existing formulas. To overcome these problems, it is necessary to arrange the implementation of learning as an alternative that is expected to improve understanding of learning in SMP Negeri 1 Proppo Pamekasan.

One alternative learning is remedial learning which is remedial learning, this can provide remedial learning assistance to students who face problem or learning difficulties, steps can be taken, namely marking or recognizing students who experience learning difficulties, know the nature and types of learning difficulties, know the background to learning difficulties, determine the possibilities of relief efforts as well as evaluation and follow up [3]. In addition to the difficulties experienced by students above, in the learning process of learning comparative material, there is a problem that the teacher only presents formulas available in the book so that students only memorize or remember the formula. After presenting the formula, the learning activities are continued by giving examples of questions and giving Student Worksheets (LKS) which only contain question exercises. Student Worksheets should not only contain practice questions. This is because Student Worksheets (LKS) can be used to direct students towards problem solving abilities in students in finding concepts individually or collaboratively, by including certain learning activities. Therefore, researchers will develop Student Worksheets (LKS) that can direct students to problem solving, linking material taught to real problems (contextual), as well as implementing collaborative learning and fostering mutual care (no students are ignored) [14],[20]. As with the characteristics of Student Worksheets (LKS) that will be developed in the above statement, the Student Worksheets (LKS) aim at getting students to gain meaningful knowledge through learning that links material to the real world. One learning concept that helps teachers link material taught with real world situations is remedial teaching. In addition to the above objectives, the Student Worksheet (LKS) that will be developed aims to direct students to engage in collaborative learning and foster a sense of mutual care (no students are ignored). This is because each student's ability is different. Collaborative learning is expected by students who first understand the material, can guide friends who do not understand and not just share the problem solution without guidance or explanation. In this way, there is no individualistic feeling that only a few students get new knowledge, but there is a growing sense of caring between friends and no one is left out of the learning process. Therefore Remedial Learning (problem solving) is implemented based on Lesson Study for Learning Community (LSLC). Lesson Study for Learning Community (LSLC) is the latest form of Lesson Study using collaborative learning and the concept of Community Learning [17,18]. According to [6],[7],[8]. Lesson Study (LS) is a model of fostering the teaching profession through learning activities conducted by a group of educators (teachers or lecturers) collaboratively and continuously to improve the quality of learning. According to [8],[23], Learning Community (LC), in practice learning uses a collaborative model where learning is designed so that each student gets the same learning rights. Therefore, the characteristics of Lesson Study for Learning Community (LSLC) are collaborative learning, caring communities, and providing jumping tasks for students' problem solving abilities.

Along with the development of an advanced era, the nation generations are required to have competencies to face challenges that are increasingly changing, one of them is problem solving ability to a complex problem [2],[21]. The aim of learning mathematics is to train the students' thinking process, one of which is the ability to solve the problems. Problem solving ability is the heart of mathematics. Solving problems area process of applying the knowledge that has been obtained previously into a new situation that has not been known. Therefore, students must be provided with the problem solving ability to familiarize them in facing the daily problems that are getting more and more complex [10],[11]. There are four problem solving strategies, each of which consists of several indicators. Indicators of the problem solving strategy are shown in table 1.
Table 1. Indicators of Problem Solving

| Problem Solving Strategies | Indicator: Understanding The Problem |
|---------------------------|-------------------------------------|
|                          | • Able to understand questions by writing. |
|                          | • Smoothly express ideas. |
| Devising a Plan          | • Able to think of the right way to solve a problem in the problem. |
|                          | • Able to choose and determine the completion steps that are easier according to the problems in the questions given. |
| Carrying Out The Plan    | • Able to solve problems in the problem by carrying out detailed steps. |
|                          | • Able to solve problems carefully. |
| Looking Back             | • Able to try or examine the details to see the direction to be taken. |
|                          | • Able to connect and find the concept of answers with questions on questions |

2. Research Methods

The research design intended in this case is a research procedure which is the formulation of systematic steps that are used as guidelines in conducting research. The research design used was based on the Thiagarajan, semmel models. The Thiagarajan model consists of four stages known as the 4-D Model (Four D Model). The four stages are the defining stage, the design stage, the development stage, and the deployment stage. The description of the four stages together with Thiagarajan's 4-D component is as follows:

2.1 Define Phase

The purpose of the defining stage is to define and define learning needs by analyzing the objectives and boundaries of the material. The defining stage consists of five main steps, namely the beginning-to-end analysis, student analysis, concept analysis, task analysis, and learning objective specifications. The defining stage consists of five main steps, as follows:

2.1.1. Front End Analysis. Activities in the initial analysis step are carried out to determine the basic problems needed in the development of learning tools. In this step, a study of relevant learning theories and future challenges and demands is examined, so that a description of the learning patterns that is considered most appropriate is obtained. In other words, this recent analysis is the main key in deciding to develop new learning materials but using the existing material in the developed SMP/MTs curriculum, with the development of tools based on Lesson Study for Learning Community (LSLC) and their influence on problem solving abilities. Grade VII students SMP the method used at this stage is the observation method.

2.1.2. Student Analysis (Learner Analysis). Student analysis activities are a study of the characteristics of students in accordance with the design and development of learning materials. Student analysis is done by looking for research subjects that can represent high, medium, and low cognitive abilities as well as from various economic backgrounds. These characteristics include background knowledge, student cognitive development and student experience both in groups and as individuals. The method used at this stage is interview and observation.

2.1.3. Concept Analysis. Concept analysis activities are intended to systematically identify, detail, and arrange concepts or materials that will be taught based on preliminary analysis.
2.1.4. Task Analysis. The task analysis activity is an identification of the main skills needed in learning in accordance with the 2013 revised 2017 curriculum. This activity is aimed at identifying the main academic skills that will be developed in learning. In this Study the task analysis stage is carried out an analysis of the material operation of addition and subtraction of integers that have been obtained in the concept analysis.

2.1.5. Specifying instructional objectives. The specification of learning objectives is intended to convert the objectives of task analysis and concept analysis into specific objectives, which are stated by behavior. The specific breakdown of learning objectives is in the preparation of learning outcomes tests and the design of learning tools. The specifications of learning objectives are Remedial planning based on Lesson Study for Learning Community (LSLC) and their influence on the problem solving ability of Grade VII students middle School.

3. Design Phase
The planning phase is a continuation of the defining stage. The purpose of this stage is to design a learning device, so that an example of a learning device (prototype) is obtained. This stage begins after specific learning objectives are established. The planning phase consists of 4 main points: test preparation, media selection, format selection, and initial planning (initial design). These four activities can be described as follows:

3.1 Criterion Test Construction
The basis of the preparation of the test is the analysis of the tasks and analysis of the concepts that are set out in the specifications of the learning objectives. The test in question is a test of learning outcomes. To design a test of student learning outcomes, a score grid and a scoring reference are made.
Figure 1. Development Research Flow Chart.
4. Research Finding

4.1 The Result of Data Analysis

The first step before conducting development research is the plan stage for asking for advice and opinions from the teachers of SMP Negeri 1 Proppo Pamekasan regarding the tools to be developed. Through discussion and collaboration with the teachers, they would be able to learn and improve the professionalism of teachers. The tools developed in this research included lesson plan, student worksheet and test. The tools were validated by 3 validators consisting of 2 mathematics education lecturers and a practitioner or mathematics teacher at SMP Negeri 1 Proppo Pamekasan and the validators also validated the research instruments consisting of observation sheets of student activities, observations on the implementation of learning tools, open class observations, and students’ response questionnaires. However, the results of tools validation are presented in chart 1 below.

![Figure 2. The Validation Result of Learning Tools and Instrument.](image)

As drawn on chart 1, it can be seen that the validation results of three validators on learning tools as if was viewed from the format, language and content aspects, it could be said “valid” since the average of validity value was at $4 < V_r < 5$ and was said to be very valid if $(V_r)$ was in interval $V_r = 5$. Meanwhile, the instruments of learning tools were also included in the same category which were valid and very valid. The overall average could be considered said to be valid. Thus, learning tools and research instruments could be used in the research.

After the validation process, the next stage was the implementation stage of Remedial mathematics learning based Lesson Study for Learning Community (LSLC). This stage was divided into “Do” stage, which was carried out in VII class and consisted of 6 meetings, they were 4 times of learning and 2 test activities (pre-tests at the first meeting and tests at the last meeting). This was also implemented to the control class but with different treatment, direct learning.

On the first meeting, that was meeting 2 up to meeting 5, different treatment was given to both classes in which the experimental class was given Remedial mathematics learning based lesson study for learning community (LSLC). by using the learning tools that has been developed while the control class was given direct learning as usual. The early learning activity of the experimental class was

| Table 2. Pre-Test Results |
|---------------------------|
|                           | N  | Minimum | Maximum | Mean    | Std. Deviation |
| pretest_eksperimen        | 34 | 3.00    | 77.00   | 33.5588 | 14.51267       |
| pretest_control           | 34 | 3.00    | 77.00   | 35.1176 | 14.50552       |
| Valid N (listwise)        | 34 |         |         |         |               |
dividing the students into a group consisted of 3-4 students. The stages in Remedial mathematics learning based Lesson Study for Learning Community (LSLC). were stimulation (giving stimuli), problem statement (statement/problem identification), data collection (collecting data), data processing (processing data), verification (verifying), and generalization (drawing conclusion/generalizing), where the students in group collaborate with each other and attention is expected to arise among students (attention Public). In Lesson Study for Community Learning (LSLC) Remedial learning students are expected to be motivated to learn from their friends about what they don't understand and those who already understand giving response in the form of assistance that can support the learning of their friends in groups. In group discussion activities, it seems that some students in the group collaborate respectively to solve the problems stated in their student worksheets. In fact, in one of these groups Solid students help one friend who doesn't understand. Instead, students control classes tend to complete their assignments on student worksheets regardless of their peers in groups so that it appears that some students are dominant in completing worksheets. Student activities in the experimental and control class are presented as follows Figure 3.

**Figure 3.** Students’ activity in group discussion in the experimental class.

Based on Figure 3 above, it appears that in the experimental class, all students are involved in the process of collaboration in completing student worksheets. Students dare to ask whether there is material that they don't understand and, conversely, students who understand material helps their friends who are still struggling. During the group discussion, there was one Quiet students are students 3 is student 1 who is asked to deal with student 2 then student 2 student 1 is trying to be dissatisfied with student answer 2 so student 4 gives another explanation. Conditions like this have a different form discussion activities in the control class. Students in the control class tend to complete individual worksheets or students sometimes only a few of them discuss. During the group discussion, there was one students who are shy about asking their groups, it is Q students. He is very quiet even though he does it do not understand the material. It is clear that students in the control class tend to ignore their friends in the group so that the collaboration process is not going well.

Students’ activity observation in the experimental class covered students’ activity in giving attention to the teacher or friend explanation, questioning or reasoning as well as discussing, finishing group task and presenting it in class. The results of the students activity observation in the experimental class showed that, from 34 students, there were 44% students was categorized as active, 50% students were quite active, and 6% students were less active. Whereas, in the control class, from 34 students, there were 15% students were categorized as active, 21% students were quite active, 56% students were less active and 9% students were not active.
The Open Class activity was conducted at the third meeting by 5 teachers from SMP Negeri 1 Proppo Pamekasan which consisted of several subjects. This model is easily adapted and adopted by teachers from various subjects in several different contexts. This activity is one of a series of learning activities based on study lessons for the learning community which are included in the viewing phase which is the observation stage of student activities during class. At this stage, the observer focuses on how students learn, while observations of how the teacher teaches and masters the material are given a small percentage. Teachers who are also observers present their observations in class during the observation activities of students and provide suggestions related to the learning process in class. They found that one positive side of the open class was that students were more motivated to be actively involved in group discussions. In addition, they see that in group discussions, there is a sense of care in the individual to help group members who do not understand the material so that eventually understand it. Thus, open class teachers become more convinced that this learning has a significant effect on students' ability to solve problems because in group discussions, the process of collaboration is actualized so students can learn meaningfully through their peers. In the last meeting which was the seventh meeting, posttest was given to the experimental and control class to find out the improvement of students' problem solving skills after participating in discovery learning based on Lesson Study for Learning Community (LSLC). The post-test results are presented in Table 3 below.

### Table 3. Post-Test Results

|                  | N   | Minimum | Maximum | Mean  | Std. Deviation | Classical Completeness Percentage |
|------------------|-----|---------|---------|-------|----------------|-----------------------------------|
| Experimental posttest | 34  | 40.00   | 100.00  | 90.1176 | 17.65625        | 82%                               |
| Control posttest   | 34  | 37.00   | 93.00   | 68.0000 | 13.32576        | 38%                               |
| Valid N (lisewise) | 34  |         |         |       |                |                                   |

The first stage before conducting data analysis was administering normality test and homogeneity test by using statistical test Kolmogorov-Smirnov for normality test. The distribution of the data would be said as normal if the value was higher or the same with 0.05. The results were presented in the following table 4.
Based on Table 3, it is shown that the significant value of students’ problem solving skill in pretest for both classes was \( \text{sig} = 0.127 \leq 0.05 \) (experiment class) and \( \text{sig} = 0.200 \leq 0.05 \) (control class), while the significant value for posttest of the experimental and control classes was \( 0.156 \leq 0.05 \) and \( 0.128 \leq 0.05 \) respectively. Therefore, it can be concluded that pretest and posttest of both classes was normally distributed. In the other hand, homogenity test was administered by using Levene’s test. The distribution of the data wound be said as homogent if the value was higher or the same with 0.05.

Based on Table 5 above, the sig value of students’ problem solving skill was \( 0.757 \geq 0.05 \) for pretest and \( 0.144 \geq 0.05 \) for posttest so it can be concluded that the data assumption of homogenous was fulfilled. This was because the significant value obtained from the test was more than 0.05, therefore, the data about students skill of problem solving (pretest and posttest) of both classes had homogenous variance. The further analysis was parametric test because the pretest and posttest data was normally distributed and homoge

5. Discussion
The findings that students improve their comprehension and problem solving skills require the participation of many parties (based Learning Caring Community), besides that caring community based learning is very effective in increasing students' understanding and self-confidence in communication. In line with this research, the results of the development of learning devices were carried out of Lesson Study for Community Learning (LSLC) to influence their influence on problem solving abilitiesand raises students’ awareness of friends in their groups who still lack understanding of the material, so students who feel able to help their friends in learning really understand the material in the worksheet. Findings in the control class found the level of problem-solving ability of students 3% in the low category, 20% in the high enough category, 59% in the high category, and 18% in the very high category. while in the experimental class it was found that there were no students whose level of problem solving ability was in the low category, 9% were in the high enough category, and 82% in the very high category. Based on the results of independent sample t-test analysis, it shows a significant value of 0,000 (\( p \leq 0.05 \)), which means that there is an effect of a significant increase in the experimental class.

6. Conclusions
Based on a general review and data analysis, it can be concluded that Remedial Mathematics Learning Based on Lesson Study for Learning Community (LSLC) Against the Problem Solving Ability of Students in the Summation and Reduction Integration Operations for Class VII SMP Negeri 1 Proppo Pamekasan is valid, effective and practical. In addition, the development of this learning tool has a significant influence on students' problem solving abilities. In the experimental class, there was a
significant increase in students' problem solving abilities which was quite high reaching 9%, high 9% and very high 82%. The average student and teacher responds positively to learning by using the results of the development of a discovery discovery learning tool based on Lesson Study for Learning Community (LSLC).

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