Planting sprouts as a context in project-based learning and lesson study for learning and community

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Abstract. This research uses a project-based learning model on the material number patterns in grade 8 junior high school. The system in this study uses Lesson Study for Learning and Community (LSC). The research method used is a design research. The research sample used was 8th-grade students at SMP Negeri 1 Palembang. Data collection includes interviews, video recordings, sound recordings, online media, and photos. The stages carried out in this study consisted of the stages of planning, trial design, and learning reflection. This study uses the context of planting sprouts as a starting point in the preparation of learning number patterns associated with the average material. The results of this study indicate that using the context of "Planting Sprouts" can help students understand the concept of number patterns in daily life.

1. Introduction
Number patterns are material learned in junior high school. The pattern of numbers is one of the subjects in the junior high school grade 8 material mentioned in the 2018 revised edition mathematics curriculum syllabus [1]. In addition, Permendikbud No. 24 of 2016 concerning core competencies and basic competencies also states the number patterns including the material that must be achieved [2]. Thus, students need to master the material number patterns in learning in junior high school.

Material number patterns studied in grade 8 junior high school include examples of patterns that are presented with visual shapes and determine the nth term and determine the number to nth pattern in a given pattern [3]. However, students still experience errors in working on problems related to number patterns, namely in solving problems with number patterns shown by the absence of students who are able to write term formulas [4]. In addition, students also have difficulty in changing a phenomenon in the real world into the form of a mathematical model [5].

Current learning often uses a teacher-centered learning approach, but based on the current curriculum, the teacher-centered learning approach is demanded to change it to a student-centered learning approach [6]. In addition, student participation is still passive and the material provided has not been able to apply knowledge to solve problems in real life, and there is no application of learning material in students' daily lives so students are less creative, less skilled and monotonous mindset [7].

Supporting learning models are project-based learning [8]. The project-based learning model has advantages in improving student learning outcomes and learning motivation [9]. The project-based learning model is quite challenging and is considered as an effective tool to actively teach students because students are encouraged not to depend entirely on the teacher [10]. So that Project Based Learning (PjBL) learning can be applied in learning.

Project based learning is complex tasks based on challenging questions or problems that involve students in design, problem solving, decision making, or investigative activities, giving students the
opportunity to work autonomously with periods a long time and finally produce tangible products [11]. As for the Then based on the 2013 curriculum project, it is expected that 21st century learning can be implemented. This is to address the demands of an increasingly competitive era. The 21st century learning reflects four things, namely: critical thinking skills (critical thinking skills), creativity (communication), communication (communication), and collaboration (collaboration) [1]. Learning that supports the above problem is LSLC.

LSLC (Lesson Study for Learning Community) is a collaborative process or collaborative learning in which students are divided into groups and they support each other to make progress for each individual specifically and the achievement of the whole group in general [12]. Also, through collaborative learning that connects students using the rules "Please Teach Me", it is very helpful for students who are low in ability or are understanding concepts that help understand high levels [13]. Lesson Study is neither a learning strategy nor a learning method, lesson study is a learning system that fosters to improve the learning process carried out by a group of teachers collaboratively and continuously, in planning, implementing, observing and reporting learning outcomes [14]. Lesson study in positive impact on learning that is raising awareness with friends, reducing the emergence of competence in learning activities, and establishing collaboration between students in learning [15].

PMRI originated from Realistic Mathematics Education (RME) which has been developed in the Netherlands from the beginning 70s [16]. PMRI is a learning theory that starts from the 'real' or experienced by students, emphasizes the skills of the process of 'doing mathematics', discussing and collaborating, arguing with classmates so that they can find themselves (student inventing) as the opposite of (teacher telling) and ultimately using mathematics to solve problems both individually and in groups [17]. PMRI was developed not only to implement new ways of teaching and learning mathematics but also to achieve social transformation in Indonesia [18].

PMRI has five characteristics: (1) using real life contexts as a starting point for learning; (2) using models as a bridge between abstract and real, which helps students learn mathematics at various levels of abstraction; (3) using students' products or strategies as a result of doing mathematics; (4) interaction is very important for learning mathematics between teacher and students, students and students; and (5) the relationship between strands, with other disciplines, and meaningful problems in the real world [19]. Implementation of the third characteristic of PMRI that is using products, this means students can produce a product of learning. So that the learning can be applied to Project based learning. Project Based Learning is "The learning process that directly involves students to produce a project [20]. Projects in this learning use the project" planting sprouts ".

Learning of the revolution era 4.0 at this time required e-learning based learning, one of them is Google Classroom, especially to anticipate if learning cannot be done face-to-face and face sudden obstacles such as the Covid-19 pandemic which shocked the whole world causing all activities to be restricted [21]. Google Classroom is an internet-based service provided by Google as an e-learning system based virtual class as a form of distance learning that is done through virtual internet media in cyberspace [22]. The use of Google Classroom is quite effective in learning in terms of learning planning aspects, design aspects and material making, delivery aspects or delivery methods, as learning interaction aspects, and aspects of learning evaluation [23]. Distance learning face to face (e-learning based on virtual class) with Google Classroom becomes more meaningful because the learning material provided is designed so that students more easily understand it [24].

Based on what has been stated above it can be said that mathematics learning is not immediately given formulas then practice questions. However, learning that should start from real problems both in daily life such as the contexts that are around us continues into general forms. Then, it becomes a formal form or formula. Thus, based on the above the researcher intends to conduct a study entitled Design Research of Number Patterns used Project Based Learning in SMP N 1 Palembang Class VIII.

2. Method
This research uses Design Research type Validation. The subjects of the study were students of junior high school at Palembang in 8th grades in the 2019/2020 school year. The steps of design research according to Gravemeijer and Cobb [25] are (1) the preparation stage (preliminary design stage), (2) The pilot phase includes learning piloting experimental and teaching, experiments, and (3) stages a
retrospective analysis which analysis comparing HLT with the actual trajectory of student learning in order to obtain answers to research questions. This learning uses a project-based learning model and Lesson study for learning community (LSLC) learning system. The context used is the context of planting sprouts. Learning begins with providing initial knowledge about growing sprouts before entering the material number and average patterns, then given student worksheets about the project to plant sprouts in which students look for averages and determine the pattern of a sphere. Finally, a posttest sheet or evaluation sheet is given which is useful for measuring the student's final ability after working on a student worksheet. Data collection in this study used observation, interviews, work results of student worksheets, video recordings, sound recordings, and photos.

3. Result and Discussion

The model used in this study is Project Based Learning (PjBL) and the project used is the context of planting sprouts. This study uses the Lesson Study for Learning and Community (LSLC) learning system. LSLC is a learning that uses collaboration conducted between students [26]. Collaboration requires students to work together in groups and carry out their respective responsibilities [27]. In this study the stages carried out in accordance with the stages of the LSLC are Plan, Do, and See [13].

3.1. Plan Stage

At this stage, what is done is the researcher prepares the instruments needed in the study such as student worksheets, syllabus, predicting student answers, evaluation sheets, and scoring rubrics. This learning instrument is discussed with the teacher, as a form of collaboration between researchers and teachers. At the end of the discussion, an improvement was made on the student worksheet in the form of clarifying basic competencies, at the prediction stage of the answer between the teacher and researcher about the students' ability to work on the student worksheet, language clarity so that it was easily understood by students. The problem used is based on the results of reflection in the previous stage.

3.2. Do Stage

Project-based learning syntax consists of (1) start with the essential question, (2) design a plan for the project, (3) create a schedule, (4) monitor the students and the progress of the project, (5) assess the outcome and (6) evaluate the experience [29]. Following is an explanation of learning based on project-based learning syntax.

3.2.1. Essential Question

The teacher starts learning by asking what is growth, average, and what is the number pattern. Students are asked questions about planting sprouts. The use of real-life problems in learning contiguous with PMRI characteristics using models as a bridge between abstract and real, which helps students learn mathematics at various levels of abstraction [19]. The teacher leads the students to determine the growth of the sprouts and observes the growth of the sprouts already available in the picture, students are led to know how to calculate the average and germination of the sprouts from the first day to the second day, the second day to the third day, and so on. So that at the end of this lesson students can determine the nth term formula of a sprout growth.

3.2.2. Design a Plan for the Project

The teacher gives students a worksheet containing a project to plant sprouts. The teacher gives an initial explanation of learning starting from the title, core competencies and basic competencies that must be achieved in learning, and learning objectives on the project worksheet. The project planned for this lesson is planting sprouts. This project is carried out by each student. So, students are able to learn independently in overcoming problems. The teacher guides students to work on problem 1: observing photos of sprouts growth and measuring their growth. After measuring growth, students are led to calculate the height increase of germination per day. It is when measuring the sprouts that students have difficulty calculating the increase of sprouts on the zero day to the first day. After calculating the height of the sprouts, the teacher leads the students to find the average height of the sprouts. When students
experience difficulties, the teacher tells students to ask for help from their friends by saying "please teach me" [13]. After learning is finished the teacher asks students to plant sprouts.

3.2.3. Create a schedule
Planting sprouts in this project uses soil or cotton media and places them in a dark or bright place. The teacher and students schedule the planting of sprouts by giving 5 days’ time and measuring the daily growth of the planted sprouts. Sprouts growth measurement results are written in the question table number 3. Then, the table is filled in the second meeting, which is after the sprout planting process is finished.

3.2.4. Monitor the students and progress of the project
The teacher monitors the results of the measurement of germination growth which has been poured into the question table number 3. Then, the teacher leads the students to measure the height of the germination every day and look for the average germination rate. This is useful for calculating the predicted increase in germination on day n. After completing the search for averages, students answer question number 4 about whether the results of the measurements they have done produce patterned numbers and students explain what is the reason. Then, if yes students answer question number 5 if no students answer number 6. In this question 4, students mostly answer no. So, students answer number 6 and students determine the prediction of sprouts height increase using the average increase that has been previously guided by the teacher to use the average height sprouts to look for predictions. The seventh question, students distinguish the measurement results of sprouts that are planted in dark and bright places, obtained by looking at the measurement results of his friends who are in a different place from him. The eighth question, students put forward the use of sprouting on the project worksheet, which is useful to see whether the growth of sprouts forms number patterns. the ninth question, students look for the average height increase of sprouts used to predict the growth of sprouts on the 12th day. In order to obtain the nth term formula that is the average height increase of sprouts multiplied by the number of days desired.

3.2.5. Assess the outcome
Students are shown to provide product results that have been obtained, namely the nth term formula that has been obtained and the way students look for it. So that other students will respond to the results obtained by their friends. If there are mistakes, then students will correct their mistakes themselves. In addition, the teacher also guides students to work on the road and correct solutions. This is in line with the characteristics of PMRI namely interaction is very important for learning mathematics between teacher and students, students and students [19].

3.2.6. Evaluate the experience
Students provide experiences during learning, what they get after solving problems such as knowing the difference, average and number patterns. students can predict the growth of sprouts using the average height increase of sprouts. Students can know that the pattern of numbers is the diversity of numbers. Numbers can be generalized to form certain number patterns.

3.3. See Stage
At this time, the teacher expresses feelings about the debates and thoughts that occur during learning, the way the teacher deals with students who experience difficulties that are given so the teacher must direct students to ask for help from friends in the group. Invite students to participate in learning because the study period during covid-19 must be done online. Some other observers also provide information about how to work on student questions, discuss questions about how students learn and some questions that make students hesitant in answering the various questions given.

Some previous studies such as those conducted by Parhusip, et al. [28] and show success in learning. Parhusip, et al. [28] states that Lesson Study activities that use Project Based Learning approaches and models are proven to be able to realize active and skilled students, and there is an increase in student learning outcomes that are taught with the Project Based Learning model with Lesson Study. In addition,
Yulianto, et all. [11] also stated that the application of the Project Based Learning model guided by school-based Lesson Study can improve student learning activities.

4. Conclusion
Project-based learning that uses the context of planting sprouts helps students in solving problems in daily life related to material number patterns and looking for an average of data. The result shows So that design research, PMRI, LSLC, and Project Based Learning can be applied in learning number patterns in the 8th grade of junior high school in Palembang.

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