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Students' Interaction Patterns in Learning Mathematics Based on Lesson Study

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***Abstract*—Lesson study as a collaboration of learning allows a teacher identifies detailed learning interaction patterns that occur in the class. Therefore, this study aims to identify interaction patterns in learning mathematics through the stages: plan, do and see. This study was conducted in 3 cycles involving a teacher and some lecturers as observers. It is a qualitative study with observation techniques. Observation data described in depth and narratively. The result shows that the interaction patterns of students in cycle 1 were linearly from teacher to student (T - S), in cycle 2 was a circle from teacher-students-teacher (T-S-T), and in cycle 3 was polygon form of teacher-students-students-teacher (T-S-S-T).**

Keywords—lesson study, interaction patterns, mathematics, students

I. INTRODUCTION

Lesson study as an effort to continuously educate the teachers professionally with a collaboration principle because of collaboration with fellow colleagues improves the quality of learning. It exposes detailed learning problems and offers effective solutions. Lewis [1] discusses five motives that Lesson Study can be pursued: 1) bringing the goals of educational standards to the real world in the classroom, 2) promoting improvements based on data, 3) aiming achievement of various students' qualities that affect learning activities, 4) providing fundamental needs to improve learning, and 5) upholding the value of teachers.

The five motives of lesson study take place when teachers and colleagues recognize learning problems in their class. There are many problems such as learning motivation, learning styles, and students' communication. These three aspects refer to learning interaction patterns. Tracing the interaction pattern is complicated and difficult if it has to be done by one teacher. Therefore, collaboration with several colleagues or lecturers is needed to get objective information that can be used as a basis for the improvements of learning innovations.

Learning interaction can be formed in various patterns, from teacher to student, student to students, and vice versa. The patterns have characteristics that are formed naturally. The patterns are also varied and depend on the mental or psychological condition of students' learning, and learning approach used by the teacher, and also the social conditions in the classroom. This is a preliminary picture obtained from observations at SMP (Junior high school) Cokroaminoto Palopo, SMPN 8 Palopo, and SMP 12 Palopo.

Getzels and Thelen suggested that teacher-student interaction is a powerful force that can play a major role in influencing the cognitive and affective development of students [2]. Moreover, Pianta stated Teacher-student interaction quality is multi-dimensional, in that teachers can provide support that is emotional, organizational, or instructional in nature. Teachers provide emotional support by being sensitive, responsive, warm, and aware of student interests and needs. Teachers facilitate organizational support by creating non-chaotic classroom environments characterized by clear expectations and productive learning. Teachers offer instructional support by giving clear feedback to students, creating opportunities for conceptual thinking, and modeling new vocabulary [3].

The dependence of students who are so dominant towards the teacher greatly influences the way students think that effects on learning actions. We observed that every action that arises from each student formed patterns of interaction. The interaction pattern will be different if information only occurs in one direction or if each student share ideas. One solution to observe the interaction pattern is lesson study — we design group is learning with a discovery approach through Student Worksheets and concrete teaching tools. A teacher model, observers, coverage topics, learning scenario, and worksheet decided in the planning phase. The plan results were carried out in the do phase. The result discussed again through the see phase. We did this activity in 3 cycles in order to get the learning mathematics interaction.

II. LITERATURE REVIEW

A. Lesson Study

Lesson Study is defined as a model to develop professional educators through collaborative and continuing learning assessment based on collegiality principles that help each other in learning by a learning community. If we look at the definition Lesson Study, then we find 7 keywords, namely professional coaching, study about learning, collaborative, sustainable, collegiality, mutual learning, and learning community. Moreover, the Lesson Study aims to train professional educators in order to increase educator professionalism sustainably. If there is no sustainable training, professionalism may decrease in time. Assessment

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of learning must be carried out periodically. The learning assessment cycle is carried out in three stages. The conventional training as a top-down, it means that the training material has been prepared and provided by the instructor. Oppositely, Lesson Study as bottom-up, the problem faced by teachers become the training materials in schools studied collaboratively and sustainably.

According to Takahashi [4], LS is not just a "nice to have, but a must-have." He stressed that LS provides an opportunity for classroom teachers to work collaboratively to seek effective implementation of new ideas, rather than struggle in isolation to understand how the ideas look in his/her own classroom. He elaborated that LS provides access to outside experts, the knowledgeable others, so that each teacher can understand new ideas for improving teaching and learning with concrete examples. He added that LS as a fundamental driver for professional development permits teachers to learn not only new ideas for improving teaching and learning but also helps them to develop expertise.

Lesson Study is carried out in three stages: the first stage is Plan (planning), the second stage is Do (implementing), and the third stage is See (reflecting) sustainably. In other words, the Lesson Study is a way to improve the quality of education that never end. Lesson study has a considerable role in making systemic changes. The five ways of Lesson Study are 1) bringing the goals of education standards to the real world in the classroom, 2) promoting improvements based on the data, 3) targeting the achievement of various quality of students that affect learning activities, 4) creating fundamental goals for improvement learning, and 5) having teacher values [1]. Richardson (2006) wrote that there are 7 steps in Lesson Study: making a Lesson Study team, focusing on Lesson Study, preparing a learning plan, preparing for observation, carrying out the teaching and observing it, carrying out question and answer/discussion in learning and do reflection, and plan the next step.

B. Learning Interaction Pattern

Webb [5] explains that the main distinguishing features of the cooperation than other learning setting are an opportunity to interact with the students. However, the past few decades research on interaction and class achievement reveals that researchers have just devoted a lot of attention to interactions among students in cooperative groups. Recent studies on the interaction of students in small groups have found several significant relationships between interaction and achievement of student learning.

Livingston and Borko [6] concluded that expert classroom teachers had the ability to connect students' comments and questions to the lesson objectives. They believed this was, in part, due to expert teachers' extensive and organized subject matter knowledge. The experts used the students' input as a stimulus for discussion. These teachers responded to student comments and questions with prompts, information, and questions. The expert teacher's knowledge base appears to allow him or her to teach in interactive and improvisational ways. Put another way; an expert teacher steeps his or her instruction in student-teacher interaction rather than in prescribed and pre-planned strategies and decisions.

According to Norris [7], all interaction is multimodal, and individuals' perception of everyday interactions is shaped by more than what is said. Human beings communicate through, for example, facial expressions, gaze, gestures, body posture, and proxemics - or the distance between people. "All movements, all noises, and all material objects carry interactional meaning as soon as they are perceived by a person."

Furthermore, Bruce [8] explained five strategies to encourage students' interaction, including:

1) Rich mathematical tasks

The quality of mathematics tasks is very important. A task with many solutions and allows several solution strategies opened up opportunities for students to explain and justify their reasoning. If a task involves simple operations and a single solution, then there will be little or no opportunity for students to be involved in learning.

2) Justification of a solution

The teachers explicitly ask students to justify their strategy mathematically and not just a counting procedure.

3) The students ask questions to each other.

Fostering students ask each other is a very appropriate strategy in building their communication and critical thinking skills. Various high-level questions that were unexpected before can even emerge through this process.

4) The use of waiting time

Asking questions that require high-level thinking is not very helpful if students are not given enough time to do relevant thinking. Teachers must increase the amount of time for students to respond. Providing a few seconds so they can give more detailed answers with confidence.

5) The use of guidelines to discuss mathematical ideas

These guidelines as an instructional guide help teachers and students involved in high-quality interaction lead to a richer mathematical thinking and in-depth understanding of the concept and related applications

Webb et al. [5] state that students who help each other in learning do not necessarily have a significant effect on student learning achievement. However, in Webb's recent study of the relationship between receiving explanation and problem solving, Webb argued that students might get benefit from the explanation they receive only when the explanation can encourage constructing a more concrete understanding of the problem.

The educational process is a complex process which is essentially determined by communication between the participants in it. Communication lies at the basis of interpersonal relationships that are established in school, at the basis of students' achievement, and hence in the absence of an atmosphere in which there are good relationships between teachers and students, the ability to influence the formation and development of the personality of the students is hampered and its overall progress, and the ability to improve the student's achievements. Therefore, the problem of successful and effective communication in teaching is a problem whose essential good knowledge depends on the objectives and tasks of modern education [9].

Liu [10] explains that interactions are most often associated with several questions or suggestions on effective ways of organizing peer members. However, different

features of peer interaction are found in various small groups. With a time sequence analysis of peer interactions, it was found that problems and positions were proposed mostly in the early and middle stages of learning, while conflicts often occurred in the early stages. Finally, this study suggests five patterns of peer interaction in terms of peer knowledge exchange: centralized knowledge exchange, distributive knowledge exchange, difficulties in group development, capacity constraints, and partial knowledge exchange. Further analysis of patterns of student knowledge exchange reveals that peer students' background skills play an important role in the way of knowledge exchange involved in learning activities. The students' background abilities tend to lead to certain communication patterns. For example, small groups with high-achieving peers (or heterogeneous abilities) may not guarantee the success of group work. Many of them need teachers or moderators to scaffold the process of interaction and peer learning.

III. METHOD

This research is a descriptive study with a qualitative approach conducted in collaboration between the mathematics teacher and the lecturer of the Mathematics Education Study Program. The subject is eighth-grade students. This study was conducted in three cycles which consists of three stages plan, do, and see for each cycle. Some instruments developed were teacher and students' activities observation sheets. The data were collected by observation with camcorder and field notes. The data then triangulated between the source observation result and the field notes. The data analyzed by finding the pattern of interaction through four stages: interpreting the data, reducing the data, present the data and finding the pattern of interaction.

IV. RESULT AND DISCUSSION

The observation and field note data described in table 1.

TABLE I. THE DATA OF OBSERVATION AND NOTE

Lesson Study Stage	**Cycle**		
	I	**II**	**III**
Plan	a) Teacher and lecturers team implemented the teaching materials and discussed learning scenario in syllabus and lesson plan. b) The agreed teaching materials are the surface area of a cube and a cuboid and presented by using cooperative learning with worksheets and learning media of nets. c) Teacher promoted the worksheets draft with the topic of cube and cuboid. The lecturer team changed some sentences and added some steps. d) The teacher as a teaching model and the lecture team as observers were prepared the tools (ruler, carton, scissors, glue, etc.), learning tools for the cube and cuboid nets, and learning videos.	a) The teacher and lecture team determined the topic of the surface area of the prism. b) Cooperative learning still used. However, every group had one student as a peer tutor and a leader. c) One lecture was chosen as a teaching model. The teacher and other lecturers observed and developed the worksheets and the learning tools. d) The worksheets should provide a prerequisite topic, contextual materials in order to attract the students.	a) The teacher and lecturer team determined the topic of the surface area of the pyramid. b) Cooperative learning still used. c) One lecture still acted as a teaching model. The teacher and the other lecturers observed and wrote the worksheets and prepared the learning tools. d) The worksheets wrote in the same format, but the developed exercises considered the difficultness.
Do	a) The teacher started the learning with apperception on plan figure and the area. b) When the teacher asked the square /rectangle area, the students did not answer correctly. c) The teacher used learning tools of cube/cuboid nets and the meaning of surface area. d) The students sat in the team and looked at the teacher explanation. e) The teacher shared one worksheet to each team and explained the worksheets in front of the class. f) When the students worked, the teacher visited every team to help them. g) The students asked questions to the teacher, so the teacher cannot handle all the questions. h) The teacher and students concluded the formula of surface area of cube and cuboid. i) The teacher gave the students exercises to discuss together.	a) The teacher started the lesson by asking students to read the worksheet and to observe the video of the prism and the properties. b) The teacher asked questions, and each student who answered correctly got the price. c) The teacher asked a student in each team as per tutor. The task is to help other students who found difficulties. d) After reading the worksheet, the students worked based on the directions. e) If there was a student asked a question, the teacher did not answer. The peer tutor helped the student. f) The discussion developed from and for students. The teacher just looked at the discussion of each team. g) The students discussed their work in front of the class. h) The teacher justified the conclusion from the students. i) The students solved exercises in class.	a) The teacher started the class by asking the students to read the worksheet and observed the video of the pyramid and the properties. b) The teacher asked some questions, and each student who answered correctly got the price. c) Each question from students did not answer directly by the tutor. The tutor gave a chance to other members answered the questions. d) The discussion developed by the students and for the students. The teacher just looked at the discussion of each team. e) The students discussed they're work in front of the class. f) Each student (even passive students) justified their friends' idea. g) The teacher pushed the students to draw conclusions about the surface area of the pyramid. h) Each group scored other team works. i) The students did some exercises in class with different difficulties.

TABLE II. TABLE I, CONT.

Lesson Study Stage	Cycle		
	I	II	III
See	a) The students did not master the pre-requirement topic. Therefore, the apperception should be prepared by presenting contextual problems and wrote them down to read by the students. b) The worksheets are not communicatively. The directions should be written precisely for each step. c) Student's motivation is low. Thus, the appreciation should be provided at the beginning, middle, or last meeting.	a) In order to be more communicative, the worksheets should be given for each student. b) Students' activity during the discussion started to develop through asking-questioning activity. However, the teacher still justified every students' ideas/answers. c) Students' motivation started to develop as the cause of the appreciation and the new worksheets which were more detailed.	a) The interaction between students was getting improve. They shared ideas, asked questions, and answered questions. b) The discussion was getting improved by asking questions, correcting other students' answers, and drawing a conclusion. c) The teacher was no longer answering students' questions. The role of the teacher was adding more information to the students' answers. d) Students' motivation was getting improved as the result of the appreciation and the detailed worksheets. The passive students before were getting actively answer/add other students answers.

A. Learning Activities in Cycle I

To build learning interactions, the teacher used apperception to explore students' initial knowledge and used teaching aids to overcome the concept of surface area. The teacher explained the concept directly without involving students. As a result, students still have a great dependence on the teacher, have no initiative to find out, and low learning motivation. From these findings, the interaction patterns that occur are still going in one direction. There is no two-way communication involving the teacher or fellow students. Visually, the interfaith pattern is described in figure 1.

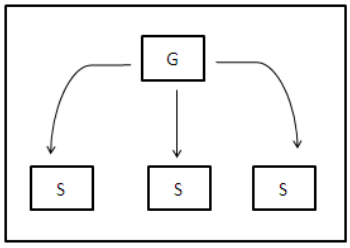

Fig. 1. Linear Interaction Interaksi

B. Learning Activities in Cycle II

Learning started by reading a student's worksheet. The teacher no longer explained the initial material, instead asks students to dig up information, ask questions, and each student who answered correctly was given a prize. With this appreciation, the students' learning motivation tends to be better. Their confidence in proposing ideas began to appear. In addition, peer tutors can also build interaction between students. If there are students who ask, the teacher does not answer. The tutor in each group immediately took the role to help his friend in answering the question. Discussions were from students and to students. But the feedback among students has not yet appeared. The teacher only observes the progress of the discussion of each group. At the end of the learning, the teacher justified the conclusions put forward by the student. The interaction is in a circular pattern like figure 2.

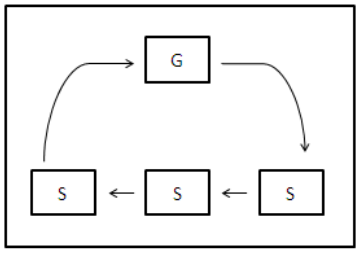

Fig. 2. Circle Interaction

C. Learning Activities in Cycle III

Some activities in cycle II were still used in cycle III such as starting the learning activities with reading, developing initial knowledge by asking questions, appreciating each student's response. Interesting findings were each question that arises from students was not directly answered by peer tutors. Tutors provide opportunities for other group members to answer questions. This indicates that their learning interactions are increasingly intense. Each student establishes a positive relationship with other students, not directly with the teacher. In fact, the students (even passive students) can justify other ideas from their friends correctly. Each group evaluates the results of the other group's work in turn. This shows a change in learning attitudes, and mentally, students already have good self-confidence. On the other hand, the teacher only encourages students to make conclusions. Learning interactions are in polygon pattern in figure 3.

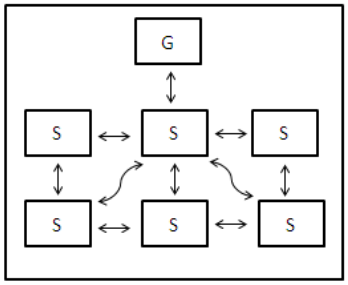

Fig. 3. Polygon interaction

V. CONCLUSION

Lesson study helps the teacher to reflect on the continuous students' learning interactions. The details of the observation allow the teacher to map the learning interactions in order to make the students active in class and to accommodate their learning needs.

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