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Lesson Study: Contemporary Motivating Tool for Active and Reflective Learning Approach

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Abstract: *Innovation of teaching approaches and motivation of students to become active and reflective learners had been at the core of education reform taking place in North Macedonia over the last 20 years. One key reform tool was the introduction of the Lesson Study. A lesson study is a collaborative approach towards developing and researching pedagogy. In attempting to implement said approach, teachers develop a deeper knowledge of both pedagogy and subject content knowledge. This leads to higher standards of educational achievement of students on all educational levels. The main purpose of this paper is to analyze the utilizing of the Lesson Study approach in thirty primary schools in North Macedonia involved in the Erasmus Plus Project: Assessment for Learning: Setting and Using Success Criteria in Math and Science Lessons in Primary Education (2016-2019). Findings indicate that the Lesson Study approach is a useful way to deal with the reconstruction of the students' role in the process of teaching and learning. Moreover, building students as active and reflective learners increase their preparedness to meet challenges of the complex social reality.*

1. INTRODUCTION

North Macedonia's primary schools have little autonomy over the curriculum and heavy syllabus load, and the lack of school autonomy limits teachers' ability to plan teaching time to be able to check for students' understanding and progress. This contributes to a large share of students experiencing significant gaps in basic competencies as they move through their path of learning. North Macedonia, among the countries participating in the Programme for International Student Assessment (PISA), has one of the highest proportions of students (52.2%) failing to demonstrate basic proficiency (Level 2) in all three domains of science, mathematics, and reading (OECD, 2016).

Classroom assessment practices are also predominantly summative and limited to a narrow range of lower-order tasks. Students receive little quality feedback to help them understand how to advance in their learning. They also have very few opportunities to demonstrate more applied skills and complex transversal competencies such as problem-solving and critical thinking (OECD, 2019, p.25). The intensive focus on summative marks and the predominant perception of assessment as a judgment of achievement obscures the other important function of assessment – providing information to improve learning. This creates a situation where teachers are not making sufficient use of assessment results to help students understand their current proficiency and determine the next steps in their learning (OECD, 2019, p.27).

In recent years there were attempts at curriculum modernization, particularly in sciences and mathematics. In 2014, the educational system in North Macedonia was set up according to the principles and standards of the Cambridge International Curriculum, particularly in sciences

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and mathematics. The Cambridge curriculum, in general, gives students more time for content mastery and strong encouragement to engage in critical questioning. It is also less based on retaining factual knowledge and more focused on scientific inquiry, problem-solving, applying knowledge and skills to real-world contexts. However, its implementation was rushed, rather than phased in gradually, grade-by-grade, and schools and teachers were not provided with adequate support (OECD, 2019). The Cambridge curriculum was introduced with a new format for lesson planning. This was rather challenging for the teachers. They were obligated to define the 'success criteria' and 'evidence of achievement' in the daily planning for teaching for the first time in their career. Teachers set objectives for their students in terms of content knowledge to be acquired, rather than of individual learner improvement over time concerning broader competencies, such as scientific inquiry and problem-solving. Moreover, it resulted in students receiving an education that is not cohesive and lacks a clear reference point that identifies what they should be working towards. They were involved in the learning process simply by completing tasks imposed by the teacher or by absorbing information presented by the teacher. Most of the activities designed by the teacher were not appropriate to the child's developing understanding. Students were struggling with their 'misconceptions' and ideas in a variety of science concept areas and were not stimulated to construct new understanding based on their previous experiences, so they were not motivated to actively participate in the learning activities. Students were passive learners in the classroom and were not supported to develop the ability to assess themselves and to take responsibility for their learning.

2. LITERATURE REVIEW

Contemporary approaches emphasize the active engagement of learners in their learning, learner responsibility, metacognitive skills, and a dialogical, collaborative model of teaching and learning. The assessment processes in which the teacher holds all the power and makes all the choices limit the potential for learner development in all of these aspects. Teachers who see dialogue and the co-construction of knowledge as a core part of their teaching conceptions need to consider the importance of inviting the learners to share more fundamentally in the assessment processes (Black & William, 1998).

Many scholars hold the view that the most powerful educational tool for improving achievement and preparing children to be successful and lifelong learners is the Assessment for Learning. The research evidence for this is rigorous and comprehensive. Assessment for Learning actively and continuously promotes the kind of learning culture that is essential to raising levels of student attainment; a culture which 'activates students as owners of their learning' and which instills in them the belief that all can succeed (Hattie & Timperley, 2007).

For students to become owners of their learning they need both to acknowledge the curricular objectives, and to be active in guiding their learning - in other words, they must become self-regulated learners. It is a widely acknowledged view that students take ownership of their learning when they assess their work, using agreed upon success criteria (Black & Wiliam, 2006). Teachers can provide students with a rubric written in student-friendly language, or the class can develop the rubric with the teacher's guidance. The teachers that are using this method report that students' self-assessments are generally accurate and students say that assessing their work helped them understand the material in a new way (Black & Wiliam, 2006). Such clarity assists teachers' assessment of pupils' achievement in science and mathematics and pupils' self and peer-assessment. This clarity will have a positive effect on the feedback teachers give to pupils both orally and written, so that they can comment on whether pupils have achieved the objective and how they might improve (Cross & Bowden, 2009).

Students owning their learning cannot occur in the absence of implementing all of the other Formative Assessment strategies. William (2011, p. 152) suggests the following to allow this to occur:

- share learning objectives with students so that they can monitor their advancement;
- promote the belief that ability is incremental rather than fixed; when students think they cannot get smarter, they are likely to devote their energy to avoiding failure;
- make it more difficult for students to compare themselves with others in terms of achievement;
- provide feedback that brings forth a recipe for future action rather than a review of past failures;
- use every opportunity to transfer executive control of the learning from the teacher to the students to support their advancement as autonomous learners.

The use of self-assessment within Assessment for Learning Policies draws on self-regulation of learning theories which identify student capabilities to set targets and evaluate progress against criteria as a basis for meta-cognitively informed improvement of learning outcomes. Self-regulation refers to self-directive and self-generated metacognitive, motivational, and behavioral processes through which individuals transform personal abilities into control of outcomes in a variety of contexts (Zimmerman, 2008).

Thus, consistent with the self-regulation theory, self-assessment contributes to greater meta-cognitive skills associated with greater achievement. Furthermore, self-assessment is associated with improved motivation, engagement, and efficacy (Munns & Woodward, 2006), reducing dependence on the teacher.

The question regarding the link between self-assessment and self-regulated learning is not whether a learner can accurately evaluate their performance (self-assessment); the key point is that learners need to be able to have an insight and assess their learning to improve it. Basically, knowing what to do next. In a study by Fontana & Fernandes (1994), learners who self-assessed and self-regulated doubled their learning rate.

One of the most common definitions of self-regulation is provided by Boekaerts and Corno (2005), who defines the concept as ‘a multilevel, multicomponent process that targets affect, cognitions, and actions, as well as features of the environment for modulation in the service of one’s goals” (p. 210).

According to Boekaerts, it is assumed that students who are invited to participate in a learning activity use three sources of information to form a mental representation of the task-in-context and to appraise it: (1) current perceptions of the task and the physical, social, and instructional context within which it is embedded; (2) activated domain-specific knowledge and (meta) cognitive strategies related to the task; and (3) motivational beliefs, including domain-specific capacity, interest and effort beliefs (2011, p. 349). At the point when the undertaking evaluation is positive, energy is enacted along the growth pathway where the goal is to increase competence.

Boekaerts describes this sort of self-regulation as top-down because the flow of energy is directed by the student. Attention shifts toward the well-being pathway, where the goal is to prevent threat, harm, or loss when the task appraisal is negative.

This form of self-regulation is termed bottom-up by Boekaerts because it is triggered by cues in the environment, rather than by learning goals. Where such bottom-up regulation is the norm, then the learning is evidently compromised. However, in certain cases, it can be positive, because by temporarily attending to well-being, the student may find a way to shift energy and attention back to the growth pathway. Of course, the relationship between top-down and bottom-up pathways of regulation is dynamic, rather than being a stable feature of an individual learner. One of the major strengths of the dual-processing model is that it bolsters up the integration of a wide range of perspectives on the broad idea of activating students as owners of their learning, including the relationship between motivation and interest, the way that learners attribute their successes and failures in learning, and how they develop ideas about their self-efficacy.

For example, when students are interested in a task, they are likely to engage in activity along the growth pathway (Hidi & Harackiewicz, 2000). When students are not personally interested in a task, interest may be sparked by something in the task situation, thus also triggering activity along the growth pathway. Where interest is not the main driver of attention, considerations of task value versus cost will become important (Wigfield and Eccles, 2002).

In terms of the theories of motivation proposed by Deci and Ryan (1995), activity along the growth pathway is associated with motivation stemming from values within the individual while activity along the well-being pathway is associated with values originating outside the individual.

In terms of the achievement goal theory, students displaying mastery orientation are likely to be activating the growth pathway, while those displaying performance orientation are likely to be activating the well-being pathway.

Self-efficacy beliefs (Bandura, 1977) can drive progress along either pathway. Along the growth pathway, self-efficacy drives adaptive cognitive and metacognitive strategy use, whereas, along the well-being pathway, self-efficacy beliefs are likely to steer the learner away from performance-avoidance goals and toward performance-approach goals.

Similarly, views of ability as incremental (Dweck, 2008) help the learner stay on the growth pathway, whereas entity views of ability direct activity toward the well-being pathway, where details of the task-in-context, appraised in the light of views of personal capability, will influence decisions about whether to engage in the task.

Finally, it is unavoidable to look for explanations and meaningful knowledge in Bloom's Learning and Bloom's Revised Learning Taxonomy. The revised taxonomy offers a plethora of active '-ing' verbs to account for the fact that learning is an active, bilateral and engaging process of internalization of knowledge with stakeholders at both ends working towards the same goal. The original teaching and learning taxonomy (Bloom, 1956) explains the cognitive processes through action verbs, by which the learner would move from cognition to meta-cognition. For the purpose of active learning, the authors refer to Bloom's Revised Taxonomy (figure 1). A teacher who possesses the ability to impart knowledge and spur learning motivation is an educator who has realized the 'link between old-fashioned teaching' and the current motivational considerations in the classroom (Anderson & Krathwohl, 2001).

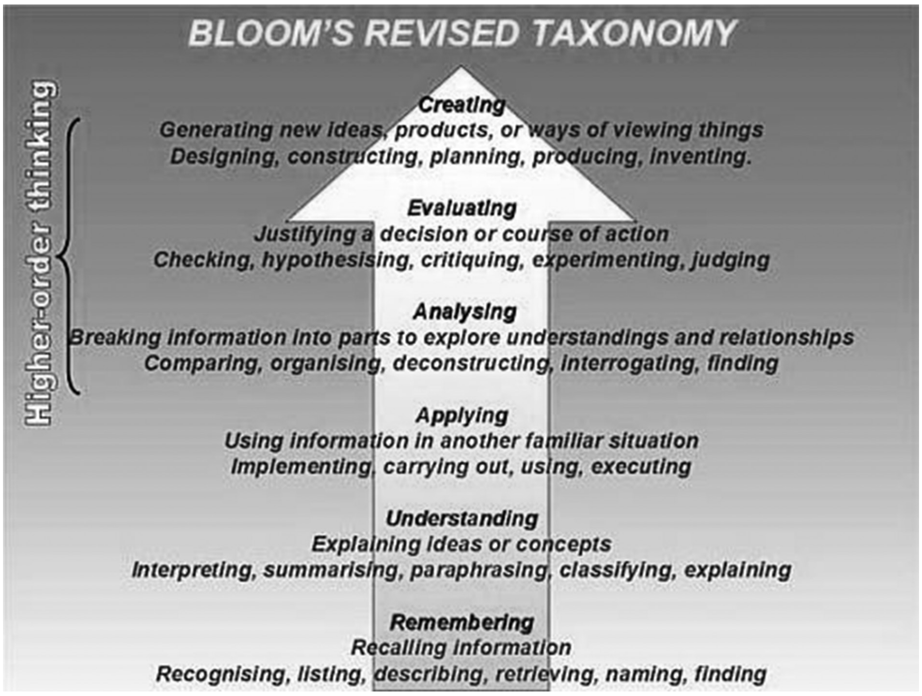

Figure 1: Bloom's Revised Taxonomy

2.1. Project Assessment for Learning – Setting and Using Success Criteria in Math and Science Lessons in Primary Education

The project activities implemented in the Project: Assessment for Learning: Setting and Using Success Criteria in Math and Science Lessons in Primary Education supported teachers with assessment for learning (ASL) pedagogies in math and science by providing resources for professional development of teachers. In order to achieve sustainable improvements in math and science teaching, the Project aimed at supporting 'communities', i.e. small teams, communities of practice where teachers and other relevant players cooperate and collaborate with a view to learn autonomously as well as support the learning of others. A particular form of collaborative practice that is frequently described as being effective at improving teaching is the Lesson Study, in which groups of teachers meet regularly over long periods to work on the design, implementation, testing, and improvement of a specific lesson.

3. TOOLS AND METHODS

A lesson study involves backward design which starts with the clarification of the goal or endpoint of the learning process and then the design of instructional experiences that lead to the goal. During the lesson design phase, teachers talk about how students are likely to respond to each element of the lesson. Teachers try to anticipate how students will interpret the subject matter, what kinds of difficulties they may experience, and what kinds of experiences are likely to support their learning. The pervasive concern with student learning throughout Lesson Study distinguishes it from other types of teaching improvement activities (Dudley, 2012).

A lesson study consists of a cycle of at least three 'research lessons' that are jointly planned, taught/observed, and analyzed by a Lesson Study group (Dudley, 2013).

3.1. Tool: Lesson study

A lesson study is a form of professional development in which a team of teachers determines a science focus, collaboratively studies student thinking about the topic, designs a lesson about this content, implements the lesson while collecting detailed evidence of student learning, and reflects on the impact of the lesson on student learning and behavior (Dudley, 2012; Elliott, 2019). A lesson study cultivates teachers' capacity for formative assessment by placing student thinking front and center throughout. According to Black & Wiliam (2008, p.2), assessment refers to "all those activities undertaken by teachers, and by their students in assessing themselves, which provide information to be used as feedback to modify the teaching and learning activities in which they are engaged. Such assessment becomes 'formative assessment' when the evidence is used to adapt the teaching to meet the needs." The Lesson Study process encourages careful observation and analysis of student thinking, intending to design and implement effective teacher responses to student actions. Additionally, it consists of a cycle of at least three 'research lessons' that are jointly planned, taught/observed, and analyzed by a Lesson Study group (Dudley, 2013) following the phases:

1. **Study**: This stage begins with the teachers identifying a specific science focus. The team then studies textbooks and research on the chosen content, identifying common misconceptions or gaps in student understanding and investigating possible teaching methods. Teachers frequently develop assessments to understand how their students conceive of concepts that underpin the target content. These assessments will become formative when the results are used in the planning phase to guide instructional design.
2. **Plan**: Planning the research lesson is guided by the results of the study phase, thus continuing the focus on student thinking, and transforming the pre-assessment into formative assessments.
3. **Teach/Observe**: In implementing a research lesson, a member of the Lesson Study team (the presenter) teaches the lesson; the remaining members of the team, supported by outside experts, carefully observe and record students' science work, actions, and comments. These observations provide evidence for the post-lesson analysis and reflection. The presenter has a dual assessment role during the lesson, to implement the formative assessment designed in the planning stage, and to respond to unplanned student actions and reactions that reveal unexpected understandings and misunderstandings.

   An important component of formative assessment is the ability to gather evidence about student thinking. In a research lesson, the team members who are not teaching the lesson are tasked with observing and carefully recording moments, behaviors, and science work, to assess students' understanding and engagement with the science. By focusing on observation only (rather than teaching) during the research lesson, a teacher-observer has a chance to listen carefully to students' comments, observe students' actions, and discern nuances that might otherwise go unobserved. Observations, students' work, and often a video recording of the lesson provide the grist for the post-lesson analysis.
4. **Reflect/Modify**: The post-lesson analysis requires dedicated time to reflect on how well the lesson plan anticipated students' needs, to what extent and in what ways students benefited from the lesson, how the content might be better taught in the future, and how instructional practice can be enhanced for other content as well. This stage deepens the ability to put assessment to use and make it 'formative.' The reflection process starts with teachers examining evidence collected during the research lesson: student work, notes from observations, and video or audio of the lesson, if available. They ask questions regarding students' understandings, conceptions, learning, and engagement. The safe and relaxed environment of reflection in lesson study also allowed the team to ask what opportunities they might have missed, both in lesson design and in its implementation. Collaborative reflection around these questions and potential modifica-

tions of the lesson support teachers' inclination and ability to ask themselves similar questions in the flow of teaching and to adapt instruction based on their answers.

Great efforts to improve teaching and develop teachers have drawn increasing international attention toward lesson studies over the recent decades (Dudley 2015; Lewis, 2002; Huang, Fang & Chen, 2017). There is a long list of terms for lesson study in literature. Therefore, it could be recognized as a practice-based, research oriented, collaborative model of professional development (Fernandez & Yoshida, 2004; Stigler & Hiebert, 1999) which includes the key elements: active and collaborative study of content, embedded follow-up feedback, and building increasingly coherent knowledge, beliefs, and routines (Desimone, 2009). An extensive list of studies has demonstrated positive effects of Lesson Study in terms of transforming teaching (Lewis & Tsuchida, 1999; Stigler & Hiebert, 1999), promoting teachers' growth (Puchner & Taylor, 2006), sustaining professional learning communities (Banister, 2015), and improving students' learning (Lewis & Perry, 2017). Specifically, Lewis, Perry & Hurd (2009) demonstrated that Lesson Study can improve teachers' knowledge and beliefs, and build productive professional learning communities.

3.2. Method: Case study

At the beginning of 2017, the Project: Assessment for Learning: Setting and Using Success Criteria in Math and Science Lessons in Primary Education started with the implementation in 30 piloting primary schools in North Macedonia. A learner-centered approach to teaching and learning was introduced in the Project. The project promoted Lesson Study methodology to support the teachers' peer-to-peer collaboration and directly assist each other in creating assessments.

As part of the project, in three years, 190 teachers from 30 primary schools in North Macedonia participated in intensive training and support meetings and organized 14 full days of learning activities per one year. The teachers formed 30 science Lesson Study teams composed of three teachers, covering multiple grade levels. Each team was guided by a science teacher and adviser from the Bureau for Development of Education, to illustrate the stages of the lesson study, and its power to develop the capacity for formative assessment. In summary, the experience of one team of fifth-grade teachers, science teacher, and adviser was used.

Case Study: In this case, the selected science topic was "The Earth's Movements." The team began by reviewing the literature to identify common misconceptions and after investigating multiple sources, decided to work on the 'the Sun moves, not the Earth' and 'the Sun goes to bed at night' misconceptions (Cross & Bowden, 2009). Teachers guided by the science teacher and adviser started their discussion:

The students may think the Sun is moving because it appears to move across the sky. The Earth does not feel as if it is motion, so the students may think that the Earth is still. Much class discussion is needed.

Our language is geared towards the idea of a moving Sun. We use words like sunrise and sunset, which imply motion. Moreover, we talk about the Sun 'being at its highest point at midday'. We say, 'The Sun comes up at 6 a.m.'. Next step is to share this problem with the students so that they understand how language constructs ideas. Some younger students believe the Sun goes to bed at night or that it goes wherever it seems to disappear. So, if it appears to drop behind the *local library, they will say that is where it is all night. Related to this is the common assumption that the Sun goes around the Earth. The Sun appears to move across the sky, so, therefore, they think it just continues on its journey at night and comes around the other side in the morning. By discussion, demonstrations, and Internet simulations these ideas can be challenged.*

At the end of this phase, the team decided to design a lesson targeting the underlying reasoning for the misconceptions.

Planning for effective formative assessment during the lesson plays an important role in the research lesson plan. Teachers consider questions such as these:

1. *What are the key points to check for understanding during the lesson?*
2. *What evidence might indicate that students are confused or are ready to move on?*
3. *How might a teacher respond to student understandings (to deepen them) and misunderstandings (to correct them)?*

The first question guides teachers in assessing the development of student understanding during the lesson; the second and the third question transforms that assessment into formative assessment by planning adaptations of the instruction in response to student actions.

The lesson plan presented in Table 1 provides an example of how the team used their conclusions from the pre-assessment to plan initial instruction as well as a formative assessment for their lesson.

4. RESULTS AND DISCUSSION

Within the project, four cycles of Lesson Study-based learning activities in science were organized. Each cycle contained planning of the learning activity, application of the plan in the classroom, and discussion of the results of classroom learning activities. Learning activities that used problem-based learning and scientific enquiry models were started by providing an open problem to students.

Based on the results of reflection put forward by the observers, in the first and second cycles, the implemented learning activities indicated that the students' ability to express the given problem was still not visible and the ability to contribute or provide scientific arguments was also still exceptionally low. In the first cycle, students could still not synthesize and provide the correct solution to the problem given. It was concluded that students have a sufficient level of developing critical thinking skills, yet they still feel discouraged to publicly state their thoughts. The results of the first cycle reflections were basic for improving learning activities by the Lesson study team. In the next cycle, a discussion plan recommended a learning activity by using 3 spheres - Earth, Sun, and the Moon. They were asked to model how the Earth and Moon move around the Sun. They worked collaboratively in groups of 3; the first students worked individually and then were asked to discuss the results of their thoughts in the group. Each student was allowed to express her/his opinions. This allowed those who were passive to be encouraged to share their opinions about the problem topic. Students who still did not understand would get knowledge through explanations given by other group members. If all members of the group had no understanding of the topic, the teacher provided an opportunity and chance to ask other groups. The results of the group discussions were brought into class discussions. The teacher chose one group to present the results of his work in front of the class. The results of observations from learning

Table 1. Lesson plan

<table>
<tr><td colspan="3">Week beginning: Week 12, lesson 1</td><td colspan="3">UNIT: The earth's movements</td><td>CLASS: Grade 5</td></tr>
<tr><td rowspan="2">Timing</td><td rowspan="2">Learning objectives</td><td rowspan="2">Success criteria</td><td colspan="2">Activities</td><td rowspan="2">Resources</td><td rowspan="2">Evidence of achievement</td></tr>
<tr><td>Description</td><td>W/G/I</td></tr>
<tr><td>10
5
20
5</td><td>Explore through modeling that the Sun does not move; its apparent movement is caused by the Earth spinning on its axis.
Make relevant observations.</td><td>I can use a model to demonstrate that the Sun does not move.
I can use a model to show how the Earth rotates and this causes day and night.
I can use a model to show how the Earth orbits the Sun and explain that this takes 1 year.
I can use a model to show how the Moon orbits the Earth and explain that this takes 28 days.</td><td>Ask the students what they already know about the Earth, the Sun, and the Moon by drawing a diagram and annotating it with facts they know (what type of celestial body they are) or how they move in relation to each other.
Key questions:
"What direction does the Sunrise in?
"Which direction does it set in?"
Explain that these questions are "trick" questions and that although it looks as if the Sun is moving across the sky, actually it stays still.
"If the Sun isn't moving, what must be?"
In pairs, ask students to talk to each other about what must be happening. Share ideas from students.
Explain to students that they are going to use 3 spheres to make a model of how the earth and moon move around the Sun. In front of the whole class, ask for 3 volunteers to show this. Encourage the use of key vocabulary, orbit, rotate, and the 1 day, 28-day and 1 year cycles.
Ask students, in 3s, to repeat this model for themselves. Encourage them to talk about what is happening throughout the activity e.g. I am the Sun and I am not moving. I am the Moon and I am orbiting the Earth. It takes me 28 days to get all the way round.
Ask students to return to their diagram from earlier and with a different color pen, add any new information they have learned.
Students self-assess their knowledge and skills based on the success criteria.</td><td>Individual
Pairs/Whole class
Whole class
Group
Individual</td><td>Paper, pencils, football, marble, pea, drawing equipment</td><td>Modelling
Questions and Answers
Observation
Modelling</td></tr>
<tr><td colspan="3">Organization: Details of differentiation/groups / adult role (linked to activities)</td><td colspan="3">Notes / extension opportunities / homework</td><td>Key vocabulary</td></tr>
<tr><td colspan="3">Adults to support groups as they model the movement of the Earth and Moon.
Encourage students to talk about what is happening.</td><td colspan="3">Extension for higher achievers – use other media (textbooks, Internet) to research the sizes and distances apart of the Sun, Moon and Earth.</td><td>Sun, Earth, Moon, orbit, rotate, star, planet, moon, observe</td></tr>
</table>

activities for cycles 3 and 4 indicate that some students have shown an increase in their ability to express the opinions regarding the problem`s given. In groups, students were able to find relevant facts in providing explanations related to the solution that they have chosen. According to observers, students who were allowed to be involved in the discussion could provide answers to the problem`s given, even though, some of them were still not perfect. This showed that there has been an increase in students' critical thinking skills in learning activities. The ability to think critically can be strengthened when students learn, and the ability of thinking can be implemented correctly so that students become active and reflective learners.

The process of Lesson Study-based learning activities that were carried out provided many benefits to teachers, students, and the education process, itself. Lesson study is a tool that can be utilized to improve the quality of the learning process (Wood, 2017; Bjuland & Mosvold, 2015). It was also a learning tool for all members involved in the process, ranging from planning activities to reflecting learning outcomes. All team members in their respective classes can apply the results of observations. Through Lesson Study-based learning, several important things could be considered by the team, namely (1) considering the given objectives of learning and teaching materials, (2) learning and developing the best approach of learning, (3) considering the long-term goals of learning related to the ability that should be mastered by students, (4) re-exploring knowledge related to the material to be taught, (5) doing collaborative planning activities, (6) observing the learning process through students' activities, (7) observing the results of learning through both students and the results observations (Risnanosanti & Syofiana, 2019).

Through the results of the Lesson Study-based learning process, students' critical thinking skills differed, before and after the learning activities. At the beginning of learning, most of the students or 55.05% were unable to organize the information given properly, had misunderstood the concept, and did not comply with the instruction; 33.72% were unable to organize information, misunderstanding of the concept, and did not do the tasks in accordance with the instruction, and still found many mistakes; 9.16% were managing simple information and giving simple answers in solving problems and 2.07% were presenting better ability to analyze information obtained from several sources so that it became more complete. After learning activities throughout the 4 cycles, the percentage of students unable to organize information and struggling with the misunderstanding lowered from 88.77% (in total) to 41.79%, but the percentage of students able to analyze obtained from several sources raised from 11.23% (in total) to 58.21%. Based on the data, it can be concluded that the application of the Lesson Study-based learning activities can increase students' responsibility for their learning process. Each next stage of the Lesson Study activity stimulated students' learning ability. Also, by providing a problem that requires completion, students' motivation and confidence increased in each next cycle. The Lesson Study-based learning activities gave students the opportunity to analyze and find solutions related to scientific problems and present them. This all may help students to improve their reflective skills.

5. CONCLUSION

Based on the results of the application of the lesson-study, it can be concluded that the learning process that employs the Lesson Study technique can improve students' critical thinking skills and their motivation to learn. In the Lesson Study-based learning process, the teacher has the opportunity to examine the best resources that can be used in learning activities through a collaborative learning process with other teachers. In such a way, the teacher can design appropriate assignments to improve students' critical thinking skills. Giving well-planned assignments stimulates the active involvement of the students, in such a way, improving students' thinking skills, especially critical thinking skills. The open problem tasks allow students to discover the concepts by themselves and form a critical understanding of the problem itself and the interrelated link to other phenomena in the complex reality. This is expected to improve the quality of learning. As a challenge, organizing such a learning process requires significant and consistent support for teachers including resources related to formative assessment, opportunities for professional development, and incentives that encourage its real-time application.

During the COVID-19 pandemic, governments relied on teachers to be the guarantors of children's learning, calling on them to respond innovatively in the face of great change. As new, more flexible approaches to the delivery of education look likely to outlive the pandemic, and education systems work to shift practices towards greater responsiveness and resilience; governments must prioritize professional learning and support for teachers (OECD, 2020). With this in mind, Lesson Study approach can support policy makers to design and implement effective professional learning activities that simultaneously enhance teachers' skills and knowledge while strengthening resilience and enabling them to thrive in changing contexts.

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