

## Establishing Learning Communities among Science Teachers Through Lesson Study

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*The fundamental philosophy embedded in lesson study is the collaborative practice of teachers working together to plan, teach, observe, reflect and refine lessons. It has been well established that collaboration strengthens teacher collegial relationships and enhances pedagogical knowledge. While teacher collaboration seems to be a norm in Japan and some other parts of the world, a similar teacher practice in lesson study is uncommon in Malaysia. This paper aims to provide an experiential narrative of the science lesson study project initiated by SEAMEO RECSAM highlighting the practical means of establishing learning communities among 17 science teachers from two primary schools and three secondary schools in Penang. The research team members were diverse: eight science educators comprising of four Malaysians, three Filipinos and a Japanese, together with the school science teachers which reflected a Malaysian multi-ethnic composition. The research enterprise attempted to address two questions, namely; (1) What is the nature of collaboration shared by the members of the science lesson study team? (2) How does teacher collaboration help improve classroom teaching and learning? In describing the collaborative features, three core components of teacher collaboration in a community or group identified by Wenger (1998) - joint enterprise, mutual engagement, and shared repertoire were used as a framework. Hence, this paper intends to share its success story in establishing learning communities among science teachers in Penang through participation in the lesson study work. By engaging in their respective communities, members strengthen their bond and develop a habit of improving their practice by working and discussing with their colleagues.*

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**Keywords:** Lesson study; Collaboration; Collegial relationship; Learning community

## **Introduction**

Early last year in 2012, when the first author visited an elementary school in Nagoya, Japan, he noticed that at the end of the school day the teachers went straight back to their staffroom after bidding goodbye to the pupils. Apparently they were not in a hurry to go home. They were seen sitting at their respective places and talking to their neighbours in small groups. Upon enquiry, the author was told that they were discussing about tomorrow's lessons: what and how they plan to teach certain lessons, the teaching materials that they have prepared, and that can be shared through the network via computers placed on their tables. Such is a unique scenario when teachers in Japan engage themselves in lesson study. Chichibu and Kihara (2013) report that Japanese elementary school teachers used to meet after school hours to discuss their curriculum and instruction. Certainly, they have established a deep-rooted school culture of participating in professional learning community through lesson study. The results of the 2010 nationwide survey showed that almost all or 99.5 percent of elementary schools in Japan practiced lesson study (Chichibu & Kihara, 2013). This data revealed that engaging in lesson study for continuing professional development is a way of life for the Japanese elementary school teachers.

The basic philosophy embedded in lesson study is the collaborative practice of teachers working together to plan, teach, observe, reflect and refine lessons. The professional communication in collaboration strengthens existing collegial relationships (Sibbald, 2009) and is known to foster deep learning and improve teaching (Diaz, et al., 2005; Lewis, Perry, & Murata, 2006; Parks, 2009) by deepening teachers' content knowledge as they plan the lesson together (Chokshi & Fernandez, 2004), sharing of expertise (Sibbald, 2009), and increasing teachers' knowledge of instruction, commitment and community, learning resources, and ability to observe students (Lewis et al., 2006; Lewis, Perry, & Hurd, 2004). Teachers' learning could also be enhanced when the lesson study group is diverse – members hold differing views, experiences and knowledge on classroom teaching and learning (Meirink, Meijer, & Verloop, 2007).

While teacher collaboration has been touted as a powerful agent for change, it is perceived as a challenging aspect of the process. In the United States (U.S.) where there is a proliferation of lesson study groups, research literatures reveal that U.S. teachers became anxious and wary of collaboration and collegial observation (Chokshi & Fernandez, 2004; Perry, Lewis, & Akiba,

2002). Apparently such discomfort and stress are being attributed to teachers' view of observation as performance evaluation (Chokshi & Fernandez, 2004) and traditional school norm of individualism, where a single teacher spends most of her or his time teaching or working with their students (Lieberman, 2009). The consequence of this practice is isolation where teachers have rare opportunity to see their colleagues teach, and neither do they converse about teaching and learning. The culture of lesson study, where teachers engage in collaborative practice and frequent professional communication, is still new in many school environments such as in Australia and Brunei (Pierce & Stacey, 2011; Shahren & Madihah, 2011) as well as in Malaysia.

In the context of Malaysia, the Japanese teachers' practice of doing lesson study is uncommon. Malaysian teachers usually mind their own businesses in teaching, very reluctant and shy to engage in discussing instructional problems with their colleagues. Opening the classroom to their colleagues for the purpose of gathering feedback on lesson development and implementation hardly ever happens. On the other hand, it is obligatory for them to be observed by school inspectorates for performance evaluation in consideration of confirmation or promotion in their teaching careers. Hence, if lesson study is to be imported abruptly into Malaysian classrooms, teachers will surely face the same predicament like their US counterparts where working together and finding a volunteer teacher to teach the research lesson would become a daunting task.

The lesson study literature offers suggestions to surmount some roadblocks to collaboration, yet they remain general. There is also insufficient discussion in the literature that explicitly describes the collaborative features of lesson study groups.

This paper aims to provide a narrative account of the science lesson study project initiated by the *Southeast Asian Ministers of Education Organisation, Regional Centre for Education in Science and Mathematics* (SEAMEO RECSAM) in collaboration with *Institute Pendidikan Guru-Penang Campus*, a neighbouring Teacher Education Institute (TEI) and five local schools. This study highlights the practical means of undermining teacher stress during the teaching of the lesson as well as focusing on the nature of collaborative relationship shared by the members of the science lesson study teams, and the way their collegial interaction brings forth learning. In particular, two questions will be addressed in this paper:

1. What is the nature of collaboration shared by the members of the science lesson study team?
2. How does teacher collaboration help improve classroom teaching and learning?

*The Context of the Science Lesson Study Project*

There were two groups of science educators involved in this science lesson study project which were carried out in the five schools in Penang, Malaysia. One group is composed of eight science educators; six coming from SEAMEO RECSAM and two from the neighbouring TEI. This group formed the research team and was referred to as RECSAM Research Team (hereafter RRT). The members of RRT consisted of diverse nationalities: four Malaysians, three Filipinos and a Japanese. The other group, conveniently referred to as Lesson Study Group (LSG), consisted of 17 Malaysian science teachers of multi-ethnicity (Malay, Chinese and Indian) coming from the three secondary and two elementary schools. The diversity of team members in RRT and LSG, as noted by Meirink, Meijer, and Verloop (2007), pre-empt a favourable condition for lesson study.

The teachers in each school formed their own lesson study team comprising of at least three but not more than five teachers. The secondary teachers taught lower/middle (Grade 7-8) secondary general science as their major subject, while the elementary teachers, who were generalists, also taught science as one of the subjects in their daily teaching routine. Table 1 shows the description of the school lesson study groups (LSG).

Table 1  
*Description of Lesson Study Groups*

Participating Schools	Number of teachers
Elementary School 1	5
Elementary School 2	3
Secondary School 1	3
Secondary School 2	3
Secondary School 3	3
Total	17

A two-round lesson study (Stigler & Hiebert, 1999) was implemented by each LSG. In the first round, the team engaged in a series of activities such as (a) lesson planning, (b) teaching and observing the lesson, (c) reflecting, and, (d) revising the lesson. The second round included the teaching of the revised or improved lesson plan by the same or another teacher at the same grade level but in a different class or group of students. The pedagogical flowchart and the processes involved are shown in Figure 1. For easy reference as well as to showcase the cyclical practice, Lee's (2010) PT4R Model was introduced to the LSG members. This is illustrated in Figure 2. In this science lesson study project, the PT4R model was incorporated with the features of the various teams to form the procedural methodology of the study depicted, as shown in Figure 3.

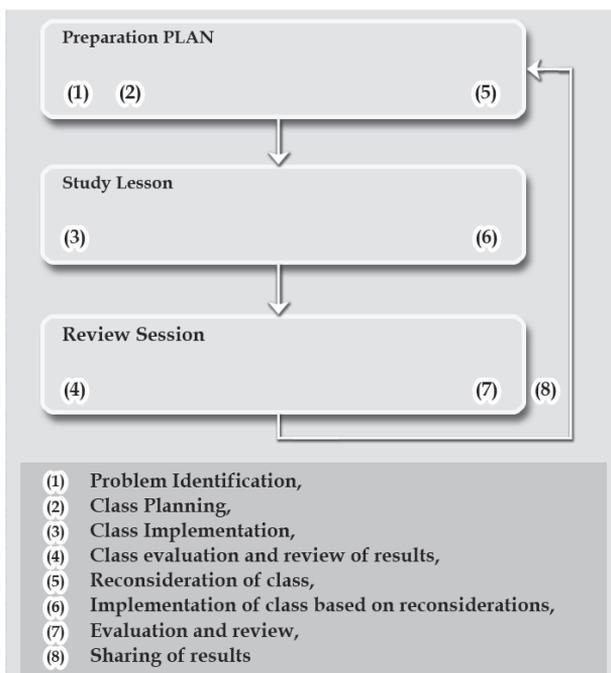
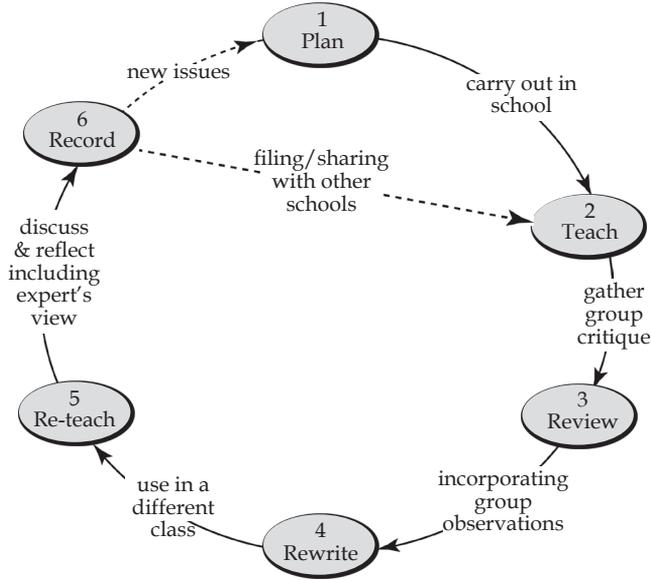


Figure 1. Pedagogical flowchart of lesson study.

Source: Redrawn from Stigler & Hiebert, 1999.



- (1) Group members discuss and draft out a lesson plan
- (2) The lesson plan is used to teach a targeted class under full view of team member observation
- (3) Reviewing the lesson conducted
- (4) Based on the feedbacks, the lesson plan is re-written.
- (5) Re-teach the lesson in another class
- (6) The group would meet again, reflect and review the lesson and record all relevant points for future reference in planning a similar lesson.

The cycle can proceed further, but usually a minimum of two cycles is sufficient to initiate improvement of a lesson.

PT4R Model to conduct Lesson Study (P=step 1, T=step 2, R=Steps 3, 4, 5, & 6)  
Source: Lee (2010)

*Figure 2. Adopting the PT4R model to conduct lesson study.*

### *Nature of Collaboration in the Science Lesson Study Community*

In describing the collaborative features of the science lesson study, the three core components of teacher collaboration in a community or group identified by Wenger (1998) were used as a framework. These comprise joint enterprise, mutual engagement, and shared repertoire. In looking at each aspect, field notes taken during post-lesson discussion, reflection notes from school teachers, and observation reports from RRT members were revisited and reviewed in order to provide descriptions of how these components became explicit in the practice of science lesson study community.

#### *Joint Enterprise*

Joint enterprise can be characterised as having a shared goal to pursue and entails joint accountability (Cheng, 2009). This goal, in the context of this article, generates a 'question of practice' when a group of teachers identifies a key issue or question relating to students' learning, and ask: what changes to our current practice are needed to improve teaching? The focus is on action to change instruction (Stephens, 2011). Such a goal will keep the group together because everyone is involved in a collective effort in meeting the challenge. The responsibility for attaining the goal is shared among group members. Hence, the common understanding of the goal is what binds them together. In this study, field notes taken during the first meeting during the half-day workshop, which was facilitated by RRT, showed that all the teams of the participating schools brainstormed earnestly to arrive at a common theme for the lesson study work, that would revolve around 'strengthening the science process skills among the students with making inferences as the main focus'. In attaining this goal, the inquiry approach was the suggested teaching strategy. The primary reason for selecting this theme was that students were weak on this aspect. Moreover, the Malaysian science curriculum strongly emphasise the development of process skills among the students and highlights inquiry approach as one of the strategies for developing these skills as well as teach the content.

#### *Mutual Engagement*

Mutual engagement exists because group members are engaged in a common negotiated activity (Rogers, 2010). In a nutshell, the team members understood that mutual engagement connotes shared responsibility. Hence, members of the lesson study teams took specific tasks or roles during the

whole lesson study process. These responsibilities deepen each member's commitment to their teams.

The science teachers involved in the lesson study group in each participating school selected the content topic and the grade level as reflected in Table 2.

Table 2  
*The Content Topics and the Grade Levels of the Science Lesson Study*

Participating Schools	Content topic	Grade Level
Elementary School 1	Strength and Stability	5 (Standard 5)
Elementary School 2	Stability	5 (Standard 5)
Secondary School 1	Simple Machines	8 (Form 2)
Secondary School 2	Heat	7 (Form 1)
Secondary School 3	Combustion	7 (Form 1)

The members in each of the LSG then devoted themselves in designing the lesson plans to explicitly embed the shared goal. Copies of these lesson plans were sent to members of the RRT for comments and suggestions. When all the members of the team came to a mutual agreement, the LSG members decided on how they would do the teaching, the teaching day and observation roles for other members. Prior to this stage, members of LSG had been exposed to a half-day workshop on how to carry out lesson study. The workshop was conducted by the members of RRT, who assumed the roles of the knowledgeable others (Wang-Iverson & Yoshida, 2005, p. 58) in the process of implementing lesson study. The modus operandi of the process in each school is explicated in Figure 3.

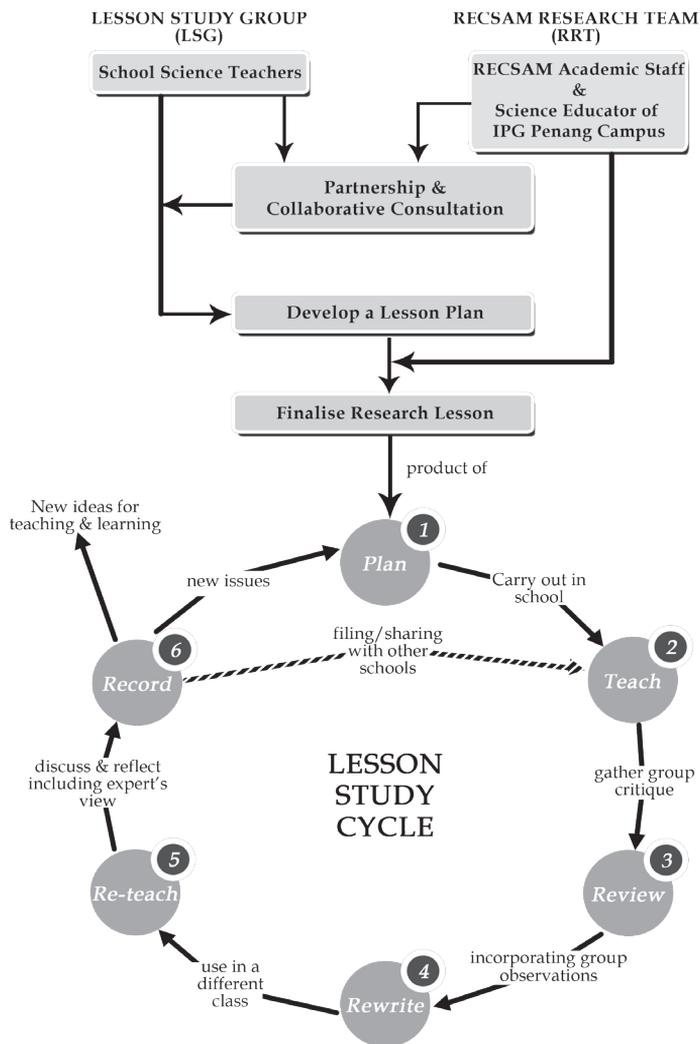


Figure 3. The modus operandi of the Science Lesson Study Project in Penang.

Source: Adapted and redrawn from Wang-Iverson & Yoshida (2005) and Lee (2010)

After much deliberation, LSG teachers from the three participating schools decided to do team teaching instead of the usual mode of one teacher teaching in front of a class. These school teams consisted of novice teachers with less than three years of teaching experience, and experienced teachers who had taught for more than ten years. This concept of collaboration in the form of team teaching surfaced to reduce teacher stress when being watched by other colleagues (including RRT members) during teaching. This gives the feeling that no individual is burdened with the task of 'showing to all'. Rather, the responsibility of instruction is distributed amongst the team members, each of whom would use her knowledge and skills to contribute to the shared endeavour. For example, in the lesson of simple machines, Teacher A began the lesson by engaging the students in exploring the various types of simple machines; followed by Teacher B guiding the students to categorise simple machines into three classes; and Teacher C leading the students to elaborate on the use of simple machines in their daily life.

The other reason for adopting team teaching is to allow students to see their teachers teaching together and supporting each other, which is akin to their experience of working with their classmates in doing a given task. In essence, teachers are modelling teamwork and team support to their students. This aspect is considered a unique feature of this lesson study work when compared to other existing lesson study projects. As a matter of fact, it is an attempt to establish a prior positive lesson study culture to appease teachers to willingly participate in the lesson study process (Chichibu & Kihara, 2013).

Upon reviewing the discussion episodes and reflection notes from the teachers, it seemed that team teaching was positively viewed and most preferred especially by the younger teachers.

I like team teaching because the other colleagues could back me up when I forgot or got lost in my teaching. It made me feel more comfortable/relaxed, confident and reduced anxiety. (Teacher C)

This is first time for me to carry out team teaching with the other teachers. We have very good cooperation and always try to help each other when we face any problem. (Teacher S)

This team teaching is a new experience in my teaching profession. At first, I felt that the bonding was loose but during the re-teaching of the lesson in the second round, the connection

was strong. I think it is a good approach in order to come out with a better lesson as members can discuss and share ideas.  
(Teacher Z)

The LSG teachers in the two participating secondary schools preferred the *lead and support* teaching where one teacher assumed the responsibility of teaching the content and the other colleagues would provide assistance or support in the form of distributing the materials or hand-outs, helping students understand, and carry out the instruction. In Secondary School 1, a female novice teacher (with only 2 years of teaching experience), was coached by two senior female teachers (with 10-12 years of teaching experience) to deliver the same lesson twice, albeit with refinement in the lesson plan in subsequent teaching, in two different classes. In Secondary School 2, both the male senior teachers (with more than 15 years of teaching experience), had adopted the *Learning Walks* method where they observed collaboratively each other's teaching in different classes of the same grade level, and identified question of practice on which further improvement can be made (Stephens, 2011) .

The RRT members did not participate in any classroom instruction but assumed specific observation roles which included; (a) a single observer recording the time, lesson flow, and teaching approaches, (b) overall student participation, monitoring responses or activities of two students randomly selected, (c) teacher's and students' questioning and answering, (d) instances of making inferences, (e) classroom/blackboard management, and (f) collegial cooperation.

Subsequent to teaching and observing the lessons, the RRT members and the school LSG team gathered together and ardently shared their reflections and observation notes. The discourse centred on the key areas in the lessons that went well and those that could be further improved. The teachers who taught the lessons gave the following comments.

The lesson went smoothly as planned. (Teacher V)

In ordinary class, my students liked to scream, shout or sleep but today they were cooperative, attentive and answered the questions though they seemed nervous. (Teacher M)

Many students were facing some difficulties like using the gas jar spoon in burning of charcoal. I should have used the charcoal powder so the whole piece didn't drop into the gas jar containing lime water or bicarbonate indicator. (Teacher K)

After the students have finished doing their experiment, we called the group leaders from 3 groups to present their results. We wrote down their results in the table on the white board. Due to time constraint, only 3 out of the 5 groups had their results displayed. It would be better if all the results of the 5 groups were displayed on the white board. (Teacher C)

It would be better to add more animation to show the movement of particles. (Teacher T)

The set induction task is not powerful or not a good booster to start the lesson. (Teacher J)

Since each member of the RRT watched closely at different aspects as the lesson unfolded, the discussion provided rich input to all members. Some of their field notes are as follows.

The flow of the lesson was good. Orientation of lesson using the video clip on "Angry Bird & the Mighty Eagle" was suitable for set induction on the topic to be taught. Teacher also replayed the video clip after telling the pupils to focus on the houses which were made of straw, wood and concrete and their shapes. This has enabled the students to focus on the important parts of the clip. (Researcher O)

The teacher showed mastery of the subject matter, exposed students to varied activities (5 or more) to show the process of combustion and its products, utilized cooperative learning with 4 small groups (6 members each and defined roles for each member like leader, recorder, reporter, time keeper, etc.) and good time management (able to finish all the planned hands-on activities; however less time for discussion.) (Researcher D)

The question raised, 'What do you infer from this activity?' might be difficult to understand. The word 'infer' may be unfamiliar to the pupils. It would be better if it had been asked, 'What can you say about it?' (Researcher L)

Experiment guide was only distributed to the whole group, not distributed individually to each students, this made students to face lack of understanding of what to do next. Only a handful of students knew what to do. (Researcher P)

The materials used were very creative without being expensive. However there were two manipulated variables tested at the same time, they were different shapes and types of material used as supporting 'beams' to hold the basket of coins. The different shapes of material used should be kept as constant variable. So, the teacher needs to find two different types of material with the same shape. (Researcher Y)

It is suggested that the teacher as much as possible will endeavour that the answers to questions must be elicited from students individually so that others will be able to hear the answer of a fellow learner and it might spark a further discussion and interaction. Also this will be a random assessment of students' understanding and a classroom management technique. (Researcher M)

The teacher might have inspired student's discussion by giving interesting questions, e.g., "Can we see convection in space station?" (Researcher N)

The post-lesson discussion took about 45 minutes with no further extension so as to minimise disruption of the teachers' regular class schedule. As such, the RRT deemed it necessary to provide a comprehensive written report after each observation as a way of keeping a record of the teaching learning process during the lesson. The report would help teachers remember, focus and organise what they need to do when they revise their lesson plan. The improved lesson plan was then used to re-teach the lesson in a different class at the same grade level.

#### *Shared Repertoire*

As the members built their community or group through joint enterprise and mutual engagement, they produced a shared repertoire of resources - language, routines, sensibilities, artefacts, tools, stories, styles, and many others that will enable the teams to understand their own state of development

from multiple perspectives, reconsider assumptions, and patterns, uncover hidden possibilities, and use this self-awareness to move forward (Wenger, 2000).

The science lesson study teams had produced communal resources: lesson plans, teaching aids, and student hand-outs which were accessible to all members and that could be shared by teachers in other schools or stakeholders as well as for future research. The collections of reflective writings and observation notes provide valuable information that would help team members reflect on their own learning trajectories (Akita, 2011).

#### *Confirming Teachers' Learning via Collaboration*

In sum, the science lesson study teams display a community of practice bound together by a common goal (joint enterprise), collective accountability (mutual engagement) and development of certain artefacts (shared repertoire). This community of practice of using lesson study for careful analysis of the presentation of a lesson can generate a powerful learning environment for teachers' professional development (Meirink et al., 2007; Pierce & Stacey, 2011). By examining the teachers' reflection notes, it became evident that their participation in the science lesson study project was valuable and enriching in building professional growth, both for the less experienced teachers and the more experienced ones. It was apparent that communication and collegial interactions among the members in the collaboration process had influenced and contributed much to their learning. The less experienced teachers in particular had changed their ways of thinking about lesson planning and implementation after participating in lesson study. They valued the contribution of lesson study to their professional development. Some of their remarks are as follows:

I feel very happy because I have the opportunity to join this project. This is a very good way to improve my teaching skills like the skill to ask question, how to use the whiteboard effectively, how to plan the activity that focus on students, how to teach the students to make inference - these all are very important for me in the future as a good science teacher. Through this project, I can clearly see the improvement in our teaching skills between two classes. We all become more confident and it really helps us in professional development as a teacher (Teacher S)

Lesson Study is very good for teachers like us because it gives us the chance to enforce our lesson more effectively with the help of our colleagues. (Teacher E)

It helps me in my professional development and in life-long learning. (Teacher C)

As for me, still new in teaching profession, I was very lucky to learn all this and it helps me a lot in my professional development. (Teacher Z)

The reflective writings from the more experienced teachers illustrated how lesson study influenced them and stimulated new ideas as they made the following statements:

It helps teachers know their weaknesses and teachers would be able to rectify the mistakes in the future. As for me, it was a great experience and I felt that I was actually doing my practical teaching/micro teaching again. (Teacher M)

It is very exciting and good experience. Sort of rekindles my teaching enthusiasm. (Teacher K)

After the first lesson study, I have a clearer picture about lesson study. We shared more after that. We started to think about better teaching approaches that can attract and help students. Lesson study can help us improve the teaching approach among the Science teachers in our school. Lesson study gave me an idea. I will write interesting lesson plans, share them with teachers and lecturers so that I can improve it and compile the entire lesson plans into a book. I think it is a quite interesting and useful idea for young teachers. (Teacher L)

These reflections clearly show how lesson study builds pathways that enable continuous growth of the knowledge and interpersonal connections that lead to improved instruction (Lewis, 2005). Lesson study also provides a pathway for teachers to think and rethink new ideas that will contribute towards the professionalism of teaching and for the successful transition of the less experienced teachers towards becoming expert teachers.

### *Challenges to Collaboration*

When lesson study was launched in the participating schools, some challenges emerged when teachers first experienced working and learning together. One roadblock is finding the time to meet with their colleagues. One teacher from Elementary School 1 voiced her concern that they had limited time to discuss their plan for the lesson. Another teacher from the same school expressed her time preference to do lesson study, particularly before June or after the Final Exam so they can dedicate more time for planning. In Secondary School 1, teachers felt that they had limited time for lesson preparation due to scheduled school examination. Even in Japan, it is difficult for any school to conduct lesson study frequently (Isoda, Stephens, Ohara, & Miyakawa, 2007). Indeed, considerable time and human resource are required for the lesson study process. Usually the teachers in a school would set a research theme for lesson study at the start of the fiscal year, and then set a schedule of implementing it in the school at an appropriate time (Chichibu & Kihara, 2013).

Hence, freeing teachers' schedule to accommodate lesson study is a challenge to any school environment. The school administration needs to find ways to relief teachers from other responsibilities so they are able to work together. Liptak (2005, p. 39) unveiled how this was done through various ways by redeploying non-class teachers, pre-service teachers, specialists and special classes, support services, partner teachers, student lunch time, and teaching assistants.

In this study, Teacher L from the Secondary School 2, made a proposal to her headmistress to create special blocks in the timetable for the science teachers in the LSG of the school to enable them to have a common time for collegial interactions and observations. Approval was subsequently granted for the duration of the lesson study implementation. This was an important contributing factor in successful implementation of the lesson study in the school.

Another challenge deals with ways of attaining true collaboration to a level where group members feel comfortable questioning their own and others' thinking. By reviewing the conversation episodes during post-lesson discussions, the discourse is dominated by presenting suggestions to improve

the lessons. There were very few instances when one member critiqued the other for the method used as illustrated herein:

Why did you let the pupils do the exercise outside? How was this activity related to the lesson? (Teacher L)

Questioning each other's thinking or ways of doing enhances learning more than simply agreeing or listening to the other members' opinions or thoughts. This notion is corroborated by the research findings of Parks (2009) where collaboration did not lead to significant learning among the three pre-service teachers engaged in lesson study. Drawing from her study, the three interns usually showed agreements to others' ideas without questioning the suggested action and challenging each other's thinking when they planned the content, method, and structure of their lesson. If disagreements occurred, their arguments were based on classroom management consideration rather than on students' abilities and needs, goal of the lesson, and insights about teaching (Parks, 2009).

The kind of professional communication shared by group members may promote or inhibit growth. For optimal learning to occur, members need to develop good communication skills in order to produce meaningful meetings. Garmstone (2007) and Pancucci (2008) suggested that the first step is to practice the seven norms of collaboration: pausing, paraphrasing, probing for specificity, putting ideas on the table, paying attention to self and others, presuming positive intentions, and balancing advocacy and inquiry.

In a similar manner, Akita (2011) articulated that learning via collaboration means learning from others, and so the culture of listening is vital so that an individual can take advantage of others' ideas. She further explicated that productive participation in discourse is not limited to speaking per se but it also includes listening as well. Listening entails watching the speaker, understanding the speaker and what is being said, grasping the speaker's intention, and relating what is being heard to one's own idea and finding new meaning via questioning and clarifying .

These norms of collaboration become futile without the culture of trust, openness, and commitment (Lieberman, 2009; Samimi-Duncan, Duncan, & Lancaster, 2010). Lieberman (2009) elucidated that a norm of openness is likely to emerge when experienced team members expose their uncertainties and weaknesses to their colleagues. With openness, young or inexperienced teachers will feel more comfortable and so the sharing of ideas and opinions

become ceaseless. Team members must also trust each other's ability to contribute to the enterprise of the community and speak truthfully (Wenger, 2000).

### **Discussion and Conclusion**

The aim of this study was to describe the nature of collaboration among the members of the science lesson study teams in forming communities of learning, and to explore how collegial interaction among the members affected their learning.

It was apparent that each of the science lesson study team was able to build a community of practice where the elements of joint enterprise, mutual engagement, and shared repertoire (Wenger, 1998) shaped their participation in the lesson study work. By engaging in this community, members strengthened their bond and developed a habit of improving their practice by working and discussing with their colleagues. This evidence supported Lewis's (2005) claim that lesson study helps build a community of practice which serves as a pathway towards instructional improvement. Team members' participation in this lesson study project also confirmed that active learning on improving classroom instruction took place guided by evidence gathered by the teachers themselves, and that lesson study would play a relevant role in their professional development and life-long learning.

Using this community of practice framework is essential for it portrays a picture of what constitutes teachers' involvement in lesson study which is useful in improving or counteracting the limitations of the interactions. The ultimate goal is to maximise learning and for lesson study process to be sustainable and become a part of teachers' school practice for continuing professional development.

It is inevitable that lesson study causes teacher stress, most especially when a single teacher has to teach the lesson. This science lesson study project has provided a practical means to reduce discomfort and anxiety by doing team teaching. This technique increases volunteerism to teach the lesson, especially the young or less experienced teachers, and helps sustain lesson study implementation in schools. The main obstacle of lesson study is time constraint. School leaders can do much on this issue by creating free time for teachers so they can do lesson study, or creating *block timetable* for those who aspire for professional improvement through lesson study.

This science lesson study project has shown promising results on how teachers' instructional improvement can be enhanced through collegial collaboration in a community of practicing teachers when working and learning together. This project also showcases how a small team of knowledgeable others from a TEI (for example, in this case- SEAMEO RECSAM) was able to collaborate with a school to set up its own community of practicing lesson study, by forging close professional communication between teachers towards designing continual high quality classroom instruction for the betterment of student learning.

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