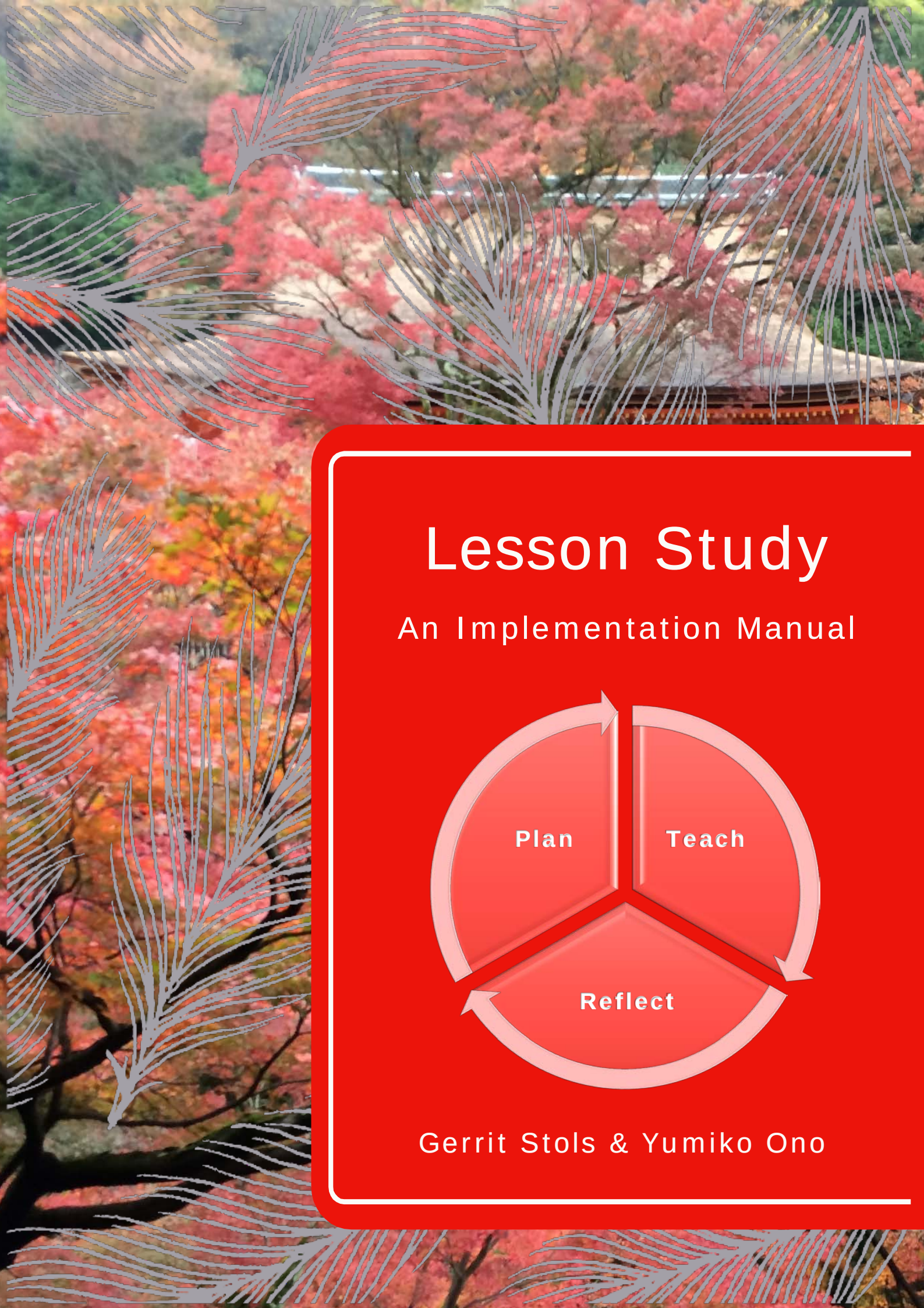

Lesson Study

An Implementation Manual

Gerrit Stols & Yumiko Ono

Lesson Study: An Implementation Manual

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Preface

Many countries look for short-term solutions for educational problems by offering one-day workshops and online courses. These interventions do not effectively address the complexity of the knowledge that teachers need to teach. Some solutions, especially the technological ones, have tried to factor out the teacher. However, why did books not replace teachers from the beginning? History has shown that all the educational solutions that try to bypass the teacher fail – there is no short route to the promised land. Learning is not only about the acquisition of knowledge – it is especially about the development of a way of thinking. Lesson Study has been used in Japan as an effective school-based professional development for many years. It is a bottom-up professional development approach where participating teachers plan (do research on) a lesson together, give the lesson, and reflect on and improve the lesson.

CONTENTS

INTRODUCTION

Lesson Study has been used in Japan as a school-based professional development for many years. It is a bottom-up professional development approach where participating teachers plan (do research on) a lesson together, give the lesson, and reflect on and improve the lesson. This cyclic improvement of a lesson continues until the teachers are satisfied with its quality. Lesson Study is more than just teachers preparing and planning together: "Lesson Study integrates teaching and research, theory and practice"[1]. It is a systematic, research-orientated inquiry into the quality of classroom learning that results in a professional community of teachers who learn together.

"Lesson Study integrates teaching and research, theory and practice"[1]

The excellent performance of Japan in international comparative tests (TIMSS and PISA) focused the world's attention on the Japanese schooling system. The TIMSS Video Study analysed lessons and identified a typical pattern of structured problem-solving in Japanese classrooms.[2] Over many years, Lesson Study practices have developed a common understanding among Japanese teachers of what constitutes an effective mathematics lesson. What the schools in Japan have been doing for many years, is now often referred to as problem-centred learning or inquiry-based learning in other countries.

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[1] Cerbin, B. & Kopp, B. (2006). Lesson Study as a model for building pedagogical knowledge and improving teaching. *International Journal of Teaching and Learning in Higher Education*, 18(3), 250-257.
[2] Groves, S., Doig, B., Vale, C. et al. (2016). *ZDM Mathematics Education*, 48, 501.

Lesson Study is not a quick fix for educational problems – there is no easy quick fix. There is however evidence that Lesson Study improves the achievements of students at school as a result of teachers' learning[3]. The most obvious evidence may be the results of countries that participate in Lesson Study in international comparative studies such as TIMSS and PISA. Lesson Study has been an essential part of Japanese education for more than 100 years and is associated with their excellent performance in international comparative studies. Lesson Study was also implemented in other Asian countries (Singapore, Hong Kong and China) that perform well in international tests. In recent years it was furthermore adopted as a professional development model in some parts of the USA, UK and many African countries. A pilot project in the UK as well as an independent evaluation of the National Strategy Programme demonstrated a positive impact on school student learning.[3]

[3] Dudley, P. (2011). Lesson Study development in England: from school networks to national policy, International Journal for Lesson and Learning Studies, 1(1): 85 - 100

WHY LESSON STUDY?

Lesson Study is a classroom-based professional development model where teachers learn together to meet their students' learning needs. The classroom reality is placed at the centre of the professional development. It is important to notice that the knowledge that teachers gain because of Lesson Study can be transferred to other lessons. Some of the benefits of Lesson Study are the following:

- Improvement of teaching skills
- Improvement of teachers' content knowledge
- Development of teachers' pedagogical content knowledge through reflection
- Building of professional learning communities
- Breaking of teachers' isolation
- Creation of opportunities for teachers to share 'best' practices
- Development of a common understanding of what constitutes an effective lesson

Many countries are looking for short-term solutions for educational problems. Short-term solutions such as one-day workshops can enhance teachers' content knowledge about a topic, but do not address the complexity of the knowledge needed to teach effectively. History shows that all those educational solutions that try to bypass the teacher fail – there is no short route to the promised land. This is especially relevant in the case of technological solutions.

Short-term solutions do not address the complexity of the knowledge needed to teach effectively.

The radio provided us an opportunity to use the best teachers' lessons and to broadcast these lessons to other classes. Then followed interventions via television, video, satellite broadcast, educational software, the Internet, eBooks, and Apps on tablets and mobile phones – but all in vain. The promoters of these interventions apparently did not understand the complexity of teaching and learning and the crucial role of a good teacher (or they just wanted to sell technology). Although an effective teacher's use of technology in class has the potential to improve students' learning slightly, the outcome is often disastrous when a poor teacher tries the same. Learning is not only about the acquisition of knowledge – it is about the development of a way of thinking.

PROBLEM-BASED LEARNING

We do not know the future – the knowledge needed by learners in 20 years' time will be different from what we teach them today. It is therefore important to teach our learners more than knowledge. Rote memorisation of facts, the ability to do calculations and the effective use of procedures will not prepare them for the future. We need a broader goal for education. The current curriculum reform in Japan focuses specifically on the development of the OECD key competencies[4].

Each Japanese lesson-planning session therefore starts with a discussion about a broader goal. These broader goals are aligned not only with 21st century skills that aim to develop human capital and stimulate future economic development, but also with the kind of learner that they want to develop for the next century.

In mathematics and science, the aim is to develop a mathematical or scientific way of thinking. We refer to these skills as process skills or thinking skills. The development of these skills should be strongly embedded in the teaching method. We can furthermore divide these learning strategies into two categories – inductive and deductive reasoning. Inductive reasoning is about the process of exploration and discovery (as explained in the following table), while deductive reasoning focuses more on justification (Why? Am I sure? Can I prove it?).

[4] OECD Competency Framework: https://www.oecd.org/careers/competency_framework_en.pdf
The Organization for Economic Cooperation and Development (OECD) is a forum where the governments of 34 countries work together to promote economic growth, prosperity and sustainable development.

	Mathematical learning strategies*	Scientific learning strategies (process skills)
Inductive reasoning (explore and discover)	Visualise	Observation and measurement
	Guess	Predict
	Experiment	Inquiry: seek information or knowledge
	Search for patterns (organise and classify)	Analysis: examine the structure of (classify)
	Conjecture (generalise)	Inference: a conclusion reached based on evidence and reasoning
Deductive (justification)	Describe	Communicate
	Explain and give reasons	Explanation and evidence
	Prove (logical reasoning)	Argument: give reasons in support of an idea
	Formal deductive reasoning (axiomatic system)	Inquiry: seek information or knowledge

The development of mathematical or scientific thinking addresses the question of how we learn. *How* we learn is in the end *what* we learn. Students develop a well-organised knowledge structure by using mathematical or scientific thinking. The formation of a well-organised knowledge structure, as well as the development of learning strategies is important.

The development of mathematical or scientific thinking addresses the question of how we learn. *How* we learn is in the end *what* we learn.

In Japan, every lesson should actualise educators' vision for their country's education. The process therefore starts by posing a challenging question or problem to the students, rather than simply presenting established facts. During the process of problem solving the learners will have the opportunity to visualise, guess, experiment, organise, classify, conjecture (speculate), and justify. This is what many call inquiry-based learning, or problem-based learning. The selection of the problem is the most important step, because a typical lesson in Japanese schools comprises the following:

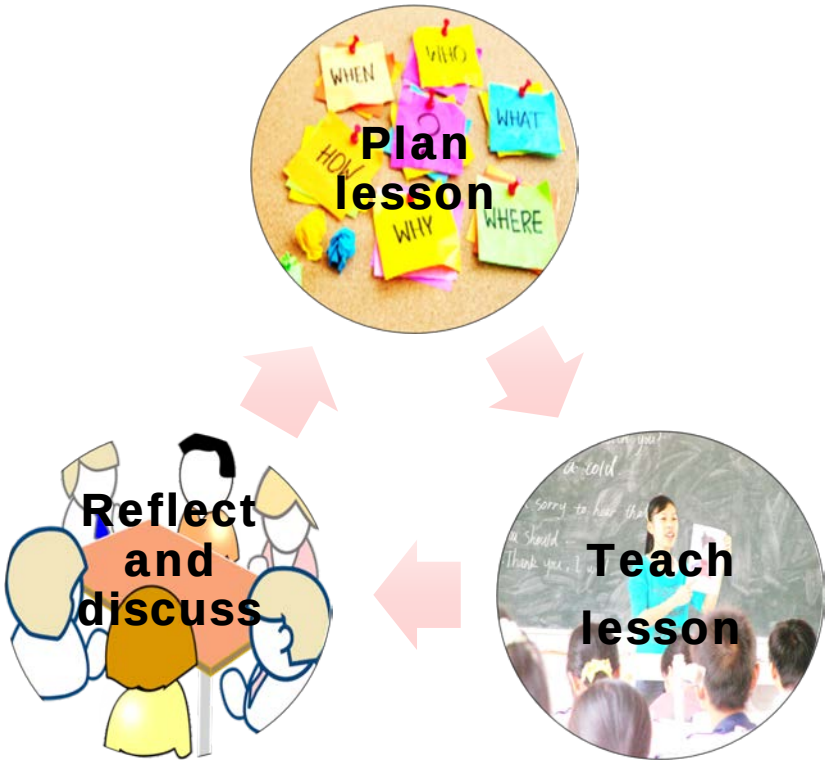
- The problem of the day is presented and clarified.
- The bulk of available time will go to learners' individual problem solving where students use inductive and deductive reasoning and in the process, develop a well-organised knowledge structure.
- Then follows the stage of compare, discuss, and conclude: this is where students get the opportunity to present, compare, describe and explain their conjectures and solutions.

The selection of the problem is the most important part of an effective lesson.

LESSON STUDY PROCESS

A Lesson Study group consists of four to six teachers who meet after school. The Lesson Study process has three components:

1. Planning a lesson in a group
2. One team member teaching the lesson while the rest of the team members observe
3. Post-lesson discussion (reflection session) and improvement of the lesson



LESSON PLANNING

The lesson planning starts with the identification of the unit objective to better understand how the specific lesson will fit into a series of lessons. After this, the main objective of the lesson being planned is identified. As mentioned, inquiry-based learning (problem-based learning) is used in Japan schools. It starts by posing a problem to students, instead of feeding them information. The first step, and probably the most challenging task, is to identify one problem that will

- give the learners the opportunity to develop the concept;
- allow productive struggling;
- build on learners' current understanding (prior knowledge); and
- promote learners' interest.

The lesson starts by posing a problem to students, instead of feeding them information.

If possible, the problem should be a real-life everyday situation. This should clarify why the new concept is important. As was indicated earlier, the selection of the problem is crucial, because a typical lesson in Japanese schools is organised as follows[5]:

- Presenting the problem of the day (5-10 minutes)
- Individual problem solving by children (10-20 minutes)
- Comparing and discussing (10-20 minutes)
- Summing up by the teacher (5 minutes)

It must be emphasised that teachers in Japan do in-depth research during the lesson-planning stage. They consider different

[5] ICME-12 Discussion Group 7: Improving teacher professional development through Lesson Study, 2012.07.23, http://www.impuls-tgu.org/en/cms/uploads/File/presentation/ICME12_DG7_Session1.pdf

possibilities, consult different sources and reflect about the consequences of their decisions.[6]

During the planning of the lesson the teachers will hypothesise and consider possible learning trajectories. They will also anticipate

- their students' thinking and interpretation;
- what they will find difficult;
- what they already know about the concept;
- learners' possible questions;
- learners' possible answers and solutions;
- possible responses; and
- possible misconceptions.

This is followed by a discussion of what kinds of support the teachers should give and what to observe during the lesson. A typical lesson plan is presented below and it is interesting to note that the first column is about the learners' activity, while the second column is about the teacher's support. This is in line with what we called a *learner*-centred approach. I do however prefer to use Yumiko Ono's term '*learning*-centred approach'.

Japanese teachers also prepare their blackboard use as part of their lesson preparation. They will rarely erase what they write on the blackboard.[7] Everything on the blackboard is well-planned and purposeful. At the end of the lesson the students can follow the progression of the complete lesson on the blackboard. (This may be the reason why I did not notice any interactive whiteboards or data projectors during a lesson.)

[6] Groves, S., Doig, B., Vale, C. et al. ZDM Mathematics Education (2016) 48: 501. doi:10.1007/s11858-016-0786-8

[7] The Japanese Kanji symbols take up less space than English words – this may be a contributing factor.

Lesson Plan[8]

Grade: ……

Teacher: ……

Date: ……

Unit topic: ……

Unit objectives: ……

Today's Lesson: Lesson …… of ……

Goal of this lesson:

……

Lesson flow:

Minutes	Learner's activity	Teacher's support
5	Understanding the topic and presenting the problem of the day More detail ……	Possible learner responses
15	Individual problem solving by students More detail ……	Possible learner responses
10	Comparing, discussing and summing up main findings More detail ……	
15	Practice More detail ……	

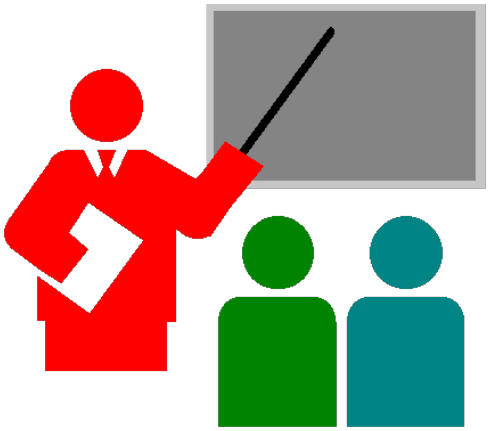
Resources: ……

Blackboard planning: When to do what, where?

[8] See the IMPULS website for excellent examples of lesson plans: http://www.impuls-tgu.org/en/

Task	Learner solutions	Consolidation

CONDUCTING THE LESSON



One of the participating teachers will be selected or may volunteer to conduct the lesson with a class. It may be a good idea to make this decision at the end of the planning session by rolling a dice to ensure the full cooperation of all the teachers to the last. The rest of the team will observe the lesson and make notes about learners' learning, actions and discussions during the implementation of the lesson. After the lesson, the teachers gather to reflect on the lesson. Their observational notes must be very specific and should record the learners' actions during a specific point in the learning process.

The observational notes must be very specific.

In Japan the actual lesson will normally be presented on a Thursday after school hours, during teachers' scheduled professional development time. Japanese schools close earlier on Thursdays and one class remains after school for the lesson (this class may come to school a bit later the next day). The topic of this lesson is the topic that should be presented on that specific day, based on their year plan. It is not a 'special' lesson.

POST-LESSON DISCUSSION AND REFLECTION SESSION

In this guide, we will discuss a Lesson Study format where only participating teachers (who were part of the lesson planning), a facilitator and an expert take part in the post-lesson discussion.[9] The reason for selecting this format is that it creates a secure and safe environment for teachers. Because the role of external role players is limited, teachers feel safe to give their opinions and accept those of colleagues to improve the lesson.

The round-table discussion should deal with the question of how we can improve our lesson to optimise learning. One person should record the discussion in writing.

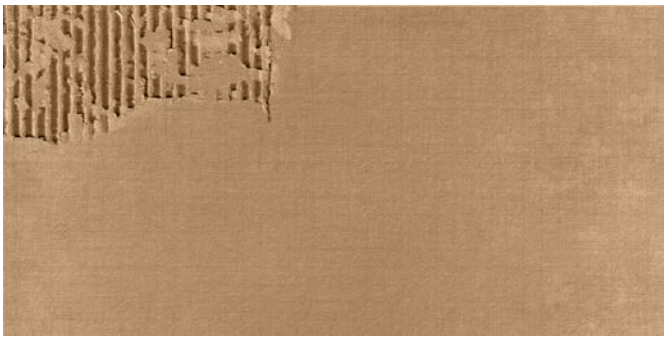
The post-lesson discussion team consists of the following members:

- Facilitator
- Team of teachers who planned the lesson
- Expert (knowledgeable other)

[9] Different formats of Lesson Study exist in Japan.

The facilitator should preferably be someone who was not involved in the lesson preparation. He/she is responsible for the organisation of the following resources:

- Lesson plan
- Two colours of sticky notes
- Cardboard
- Pens



The facilitator must lead the discussion and adhere to the following steps:

1. Allow the team about 20 minutes to reflect on the lesson and to write their responses on the sticky notes. Different colours should be used for ‘positive remarks’ and ‘possible improvements’.
2. Give the presenting teacher the opportunity to reflect on what went well during the lesson and then to discuss the difficulties he/she experienced.
3. Give each observer the opportunity to discuss the positive aspects of the lesson.
4. Next, give each observer the opportunity to discuss the possible challenges of the lesson and to justify his/her contribution.
5. Finally, give the expert the opportunity to discuss any possible gaps that were overlooked.
6. At the end of the session, thank the presenting teacher for presenting the lesson and set a date for the next meeting.

The comments regarding how the lesson could be improved must be very specific and be accompanied by clear recommendations. Use the phrase “The learning could be improved if at this specific point in the lesson …”

The facilitator must not allow discussions that critique the presenter of the lesson; focus instead on ‘our’ lesson and the learning process – the lesson belongs to the group. The target of the discussion should be the lesson, not the presenter. Do not allow comments that contain the phrase “the teacher …”. To avoid negative experiences and possible arguments, the presenter is not allowed to react on the comments or to yield to the temptation of defending the lesson. The purpose of the suggestions is to improve the group’s lesson.

The facilitators must not allow discussions that critique the presenter of the lesson.

Lesson Study is a cyclic process where teachers plan, present, reflect and improve upon a lesson. There can be up to three cycles of improvement. The group must therefore meet again at a planned date and time to improve their lesson, based on the evidence presented and discussed by the participants.

IMPROVING THE QUALITY OF LESSON STUDY

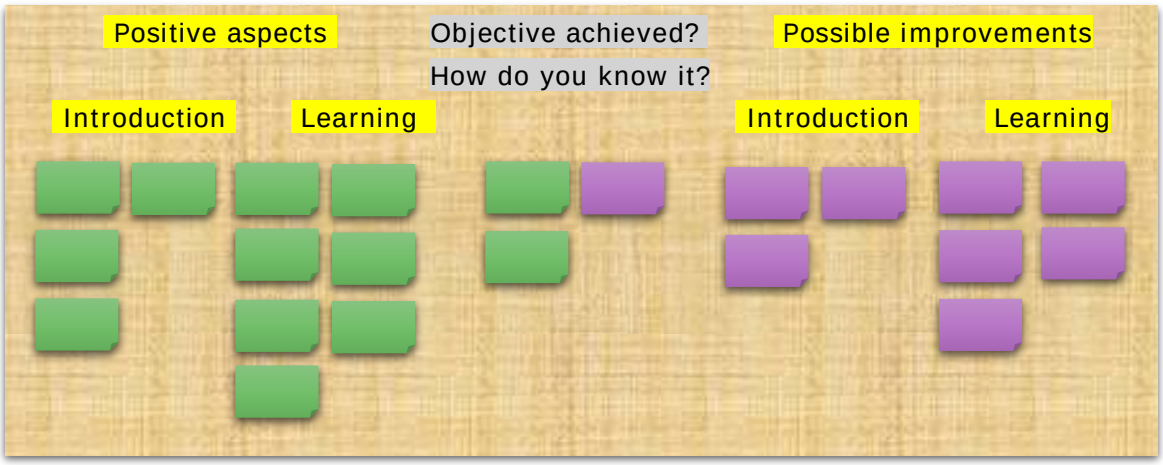
One of the challenges that countries other than Japan face when implementing Lesson Study is that their teachers often lack a common understanding of what constitutes a good lesson. These teachers also have a limited ability to observe, reflect on and improve lessons. Possible measures to improve the quality of Lesson Study include the use of an expert (experienced, effective teacher or subject advisor), interviewing a number of learners after class, reflecting on the lesson, and categorising these reflections after the post-lesson discussion meeting.

FRAMEWORK TO STIMULATE AND FOCUS THE POST-REFLECTION DISCUSSIONS

The discussion should focus on the lesson and the learning that took place during the lesson. To enhance the quality of reflection it is important to introduce a systematic method. We[10] developed the following prompts to stimulate and focus the post-reflection discussion on learning and lesson improvement:

[10] John Rogan, Yumiko Ono and I trained educational officials to implement Lesson Study in Kenya. We developed these prompts.

- General reflection on the lesson:
    - Did you achieve your objective? How do you know it?
    - How many learners achieve your objective?
    - Who did not achieve the objective? Why?
- In terms of the introduction:
    - How did the introduction stimulate learners' interest?
    - How did the introduction use challenges from daily life? (Not all lessons)
    - How did the introduction make learning enjoyable?
- Positive comments about the lesson:
    - What kind of learning occurred? When? (content and concepts)
    - What mathematical or scientific learning strategies were used?
- Possible improvements to the lesson
    - Learning could be improved if at this specific point in the lesson … (complete the statement)



Another possibly useful framework was developed by Pultorak[11]. He developed the following reflective questions to improve teachers' self-analysis:

- *What were essential strengths of the lesson?*
- *What, if anything, would you change about the lesson?*
- *Do you think the lesson was successful? Why?*
- *Which conditions were important to the outcome?*
- *What, if any, unanticipated learning outcomes resulted from the lesson?*
- *Can you think of another way you might have taught this lesson?*
- *Can you think of other alternative pedagogical approaches to teaching this lesson that might improve the learning process?*
- *Do you think the content covered was important to students? Why?*
- *What moral or ethical concerns arose as a result of the lesson?*

USING AN OUTSIDE EXPERT[12]

In our Lesson Study training in Japan, we invited subject advisors or experienced retired teachers to join the Lesson Study group. Many novice teachers find it difficult to understand learners' thinking and learning processes. This does not only make it difficult for them to accurately predict learners' possible responses during the lesson-planning phase, but also limits their ability to notice important aspects of learning during the lesson observation. Our pre-existing knowledge, understanding and beliefs limit what we can observe.

Our pre-existing knowledge, understanding and beliefs limit what we observe.

[11] Pultorak, E.G. (1993). Facilitating reflective thought in novice teachers. *Journal of Teacher Education*, 44(4), 288-295.

The role of the expert teacher[12] is to broaden the perspectives of the group and to address any gaps during the planning, observation and reflection phase. This expert is not allowed to dominate the Lesson Study process, but should guide it by asking questions about possible learner challenges, interpretations and misconceptions.

AFTER-LESSON STUDENT INTERVIEWS

Another strategy to improve a teacher's understanding of the learners' experiences, challenges and misconceptions is to interview three learners directly after the lesson. This will allow the teachers to ask specific questions to better understand what learning actually occurred, whether the objective of the lesson was met and why this happened. These interviews should be able to clarify when and how misconceptions developed during the lesson.

REFLECT ON REFLECTIONS AFTER THE LESSON

General observations and reflections are not helpful when it comes to the improvement of a lesson. The same is true of observations and reflections about logistical arrangements. It is important for teachers to reflect on their own reflections in order to move from low-level observations and reflections to meaningful reflections about the lesson.

Teachers should reflect on their own observations and reflections.

The following table classifies the reflections in terms of their content and level of reflection.[13] Teachers can just make a tick for each reflection note to indicate the location of the notes on the grid. The reflections in the top left corner are the least useful, while those in the bottom right corner are the most useful when it comes to the improvement of the lesson.

[12] An expert teacher is a teacher with a high degree of PCK (Pedagogical Content Knowledge) and a sound understanding of the content.
[13] Van Manen, M. (1977). Linking ways of knowing with ways of being practical. *Curriculum Inquiry*, 6, 205-228.

		1	2	3
	Levels	Descriptive (general remarks)	Comparative: why? (specific)	Critical: offer alternatives with reasons (specific)
1	Logistics (e.g. chairs, tables)			
2	Mode of instruction (e.g. learner-centred, real-life)			
3	Objective met?			
4	Methodology (e.g. fold paper, application)			
5	Conceptual development			
6	Development of mathematical thinking			

LESSON STUDY ASSESSMENT RUBRIC

The previous paragraph focuses only on the reflection phase. The following Lesson Study assessment rubric could be use to reflect and assess the complete Lesson Study process.

	0	1	2	3
Regular meetings	The cluster meets only occasionally or not at all.	The cluster meets regularly but they plan or discuss administrative things.	The cluster meets regularly and they occasionally plan lessons and present them to the members.	The cluster meets regularly solely for collaborative lesson planning and presenting the lesson to the members.
Planning for understanding	The cluster hardly ever plans lessons.	When the cluster plans lessons, they don't consider the problems or understanding of the learners.	When the cluster plans lessons, they consider the understanding of the learners.	When the cluster plans lessons, they identify the problems of the students and plan activities to tackle the problems.
Observation of lesson	When cluster members observe the planned lesson, they do not record their observations or focus on important aspects of the lesson.	When the cluster members observe the planned lesson, they record little of what occurs, and do not have a clear focus.	When the cluster members observe the planned lesson, they record their observations and focus on how the lesson is presented.	When the cluster members observe the planned lesson, they focus on how much the learners understand, where they have difficulties, and they record their observations.
Post Lesson reflection session	No post lesson conference is held.	The cluster members appreciate the presentation without any constructive suggestions or the cluster members point out only challenges without suggestions.	The cluster members give constructive feedback, but their focus on skills such as voice level, blackboard writing or use, group work, etc. rather than issues relating to goal achievement.	The cluster members discuss the appropriateness and effectiveness of instructional materials and/or lesson plan to achieve the lesson objectives and give constructive suggestions.
The Use of comments in Post Lesson reflection session	The comments are not recorded or used.	The comments are recorded and filed. But not used or referred to in later planning.	The comments are recorded and filed, and occasionally used and referred to in planning.	The comments are recorded and lesson planning and/or lesson presentation are improved by considering the comments made in planning and presentation.

RESOURCES

Lesson study websites

- *IMPULS: http://www.impuls-tgu.org/en/*
- *Brief Guide to Lesson Study – Catherine C. Lewis: http://www.lessonresearch.net/briefguide.pdf*
- *Dudley's Lesson Study Handbook: http://lessonstudy.co.uk/wp-content/uploads/2012/03/new-handbook-revisedMay14.pdf*
- *Lesson Study Guide: http://www.uwlax.edu/sotl/lsp/guide/*
- *Studying Classroom Teaching as a Medium for Professional Development: Center for Lesson Study, William Patterson University. http://www.wpunj.edu/coe/lessonstudy/*
- *Proceedings of a U.S.-Japan Workshop: https://www.nap.edu/download/10289*
- *Lesson Study Group at Mills College: http://www.lessonresearch.net/*
- *Chicago Lesson Study Group: http://www.lessonstudygroup.net/*
- *Lesson Study Project: http://www.uwlax.edu/sotl/lsp/overview.htm*

Research articles and books

- Cerbin, B. (2011). *Lesson Study: Using classroom inquiry to improve teaching and learning in higher education*. Sterling, VA: Stylus Publishing, LLC.
- Cerbin, B. & Kopp, B. (2006). Lesson Study as a model for building pedagogical knowledge and improving teaching. *International Journal of Teaching and Learning in Higher Education*, 18(3), 250-257.
- Chokshi, S. & Fernandez, C. (2004). Challenges to importing Japanese Lesson Study: Concerns, misconceptions, and nuances. *Phi Delta Kappan*, March, 520-525.
- Fernandez, C. & Yoshida, M. (2004). *Lesson Study: A Japanese approach to improving mathematics teaching and learning*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Fernandez, C., Chokshi, S., Cannon, J., & Yoshida, M. (2001). Learning about Lesson Study in the United States. In E. Beauchamp (Ed.) *New and old voices on Japanese education*. Armonk, NY: M.E. Sharpe.
- Fernandez, C., & Chokshi, S. (2002). A practical guide to translating Lesson Study for a U.S. setting. *Phi Delta Kappan*, October, 128-34.
- Fernandez, C. (2002). Learning from Japanese approaches to professional development: The case of Lesson Study. *Journal of Teacher Education*, 53, 393-405.
- Fernandez, C., Cannon, J., & Chokshi, S. (2003). A U.S.-Japan Lesson Study collaboration reveals critical lenses for examining practice. *Teaching and Teacher Education*, 19, 171-185.
- Hiebert, J., Gallimore, R., & Stigler, J. (2002). A knowledge base for the teaching profession: What would it look like and how can we get one? *Educational Researcher*, 31(5), 3-15.

- Lewis, C. & Hurd, J. (2011). Lesson Study step-by-step: How teacher learning communities improve instruction. Portsmouth, NH: Heinemann.
- Lewis, C. & Tsuchida, I. (1997). Planned educational change in Japan: The shift to student-centered elementary science. *Journal of Educational Policy*, 12, 313-331.
- Lewis, C., & Tsuchida, I. (1998). A lesson is like a swiftly flowing river. *American Educator*, 22(4), 12-17; 50-52.
- Lewis, C. (2002). Does Lesson Study have a future in the United States? *Nagoya Journal of Education and Human Development*, 1, 1-23.
- Lewis, C. (2002). Lesson Study: A handbook of teacher-led instructional improvement. *Philadelphia: Research for Better Schools*.
- Lewis, C., & Tsuchida, I. (1998). The basics in Japan: The three C's. *Educational Leadership*, 55(6), 32-37.
- Lewis, C., Perry, R., & Murata, A. (2004). What constitutes evidence of teacher learning from Lesson Study? *American Educational Research Association Conference*, April, 2004.
- Lewis, C, Perry, R., & Hurd, J. (2004). A deeper look at Lesson Study. *Educational Leadership*, 61(5), 18-23.
- Stigler, J.W., & Hiebert, J. (1999). The teaching gap: Best ideas from the world's teachers for improving education in the classroom. NY: Free Press.
- Yoshida, M. (1999). Lesson Study: An ethnographic investigation of school-based teacher development in Japan. Unpublished doctoral dissertation, University of Chicago.

REFERENCES

Cerbin, B. & Kopp, B. (2006). Lesson Study as a model for building pedagogical knowledge and improving teaching. *International Journal of Teaching and Learning in Higher Education*, 18(3), 250-257.

Dudley, P. (2011). Lesson Study development in England: from school networks to national policy, International Journal for Lesson and Learning Studies, 1(1): 85 - 100

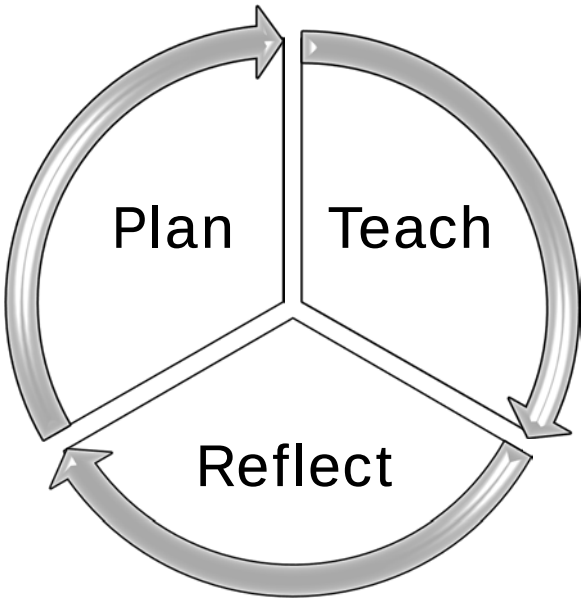
Groves, S., Doig, B., Vale, C. et al. (2016). *ZDM Mathematics Education*, 48, 501.

ICME-12 Discussion Group 7: Improving teacher professional development through Lesson Study, 2012.07.23, http://www.impuls-tgu.org/en/cms/uploads/File/presentation/ICME12_DG7_Session1.pdf

OECD Competency Framework: https://www.oecd.org/careers/competency_framework_en.pdf

Pultorak, E.G. (1993). Facilitating reflective thought in novice teachers. *Journal of Teacher Education*, 44(4), 288-295.

Van Manen, M. (1977). Linking ways of knowing with ways of being practical. *Curriculum Inquiry*, 6, 205-228.



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