Lesson Study for Professional Development

How do we help teachers develop their expertise?

GOALS

This tool provides detailed support for a workshop that introduces professional development providers and mathematics teachers to the lesson study method for ongoing professional learning.

USERS

Professional development providers and teachers.

INTRODUCTION

The path to becoming an expert mathematics teacher is a long one. While a sequence of well-focused professional development sessions can provide a good start, long-term progress involves teachers thinking about their teaching in greater depth. Becoming part of a professional learning community provides the kind of supportive environment that sustains the long-term commitment needed to build expertise. Lesson study, based on long-established practice in Japan, provides a powerful approach for the work of a professional learning community. In this workshop, we will take participants through an authentic lesson study process, illustrating each step with video clips from a lesson study that took place in the United Kingdom. The aim is that, by studying this process, participants will be inspired to set up their own lesson study communities.

Since the publication of *The Teaching Gap*[1], Lesson Study has become used much more widely across the western world as a powerful method for the professional development of mathematics teachers. The book identified the practice of Lesson Study as one of the contributing factors that has led to the high quality of teaching in Japan. While other nations strive to improve teaching through the provision of courses and other PD initiatives, Japanese teachers improve by watching and discussing classroom teaching. This is not done casually, however. Teachers spend many months preparing these 'research lessons' and often several hours discussing them in depth afterwards, under the watchful eye of an external 'expert' or *koshi*. Over time, this develops a culture of professionalism that is often missing in the western nations. This workshop can be the first step.

This is a draft version of this session – a revised version should be available Q2 2017.

SESSION OUTLINE

The times below are only indicative. Sessions may take longer than this, if done well.

- Introduction
- Professional learning communities
- The research focus
- The lesson plan
- Teaching the research lesson
- Analyzing the research lesson
- Reviewing and revising

[1] Stigler, J. W., & Hiebert, J. (1999). The Teaching Gap (2 ed.). New York: The Free Press.

MATERIALS REQUIRED

- This Leader Guide, supported by a PowerPoint: '*Lesson Study.pptx'*
- A complete set of Handouts per participant.

TIME NEEDED

2 hours

PREPARATION

The workshop leader should carefully work through this guide with the PowerPoint slides, which contain most of the material, including comments for each slide. Fill in your local information on the first and last slides. Try to anticipate the common issues that participants will have and note down your responses to them, below. The concerns shown below are typical.

Common concern	Suggested responses
What is the point of putting so much energy into the design of a single lesson?	• The primary purpose of a lesson study is not to design a lesson; it is for the participants to learn about student learning. A lesson study thus begins by identifying an issue for research. The success of a lesson study is determined by how well participants feel that they have addressed this issue. Often, the outcome of a lesson study has implications for many other lessons that a teacher teaches.
Do you need to always develop the lessons from scratch?	• No! It is often more helpful to search for an existing, high quality lesson that already addresses your research focus. The lessons at: http://map.mathshell.org/lessons.php are a very good place to start! (Well we would say that, wouldn't we!) The less writing from scratch you do, the more time you have to anticipate students responses and adapt the lesson for your students.

How long does a lesson study take? Why would teachers want to devote this amount of time?	• "It may be possible to conduct a lesson study cycle in as little as eight to ten hours, but most groups like to spend twice that time… Two or three lesson cycles during a school year is typical.." (Lewis & Hurd, 2011)[2] • We usually find that teachers are more than willing to take this time to develop their practice. This is seen as a central part of their job in Japan, not an add-on activity. As lesson study becomes embedded in the culture of a school, we find that teachers are eager to attending lesson study events. The problem is restraining them from attempting to organize too many! Quality is more important than quantity – every time.
I find that teachers hate being observed. Don't you find that teachers feel threatened by so many people observing?	• Most teachers are only observed when they are being evaluated in some way. It is natural that they feel threatened in such circumstances. Lesson study is different. Teachers are not being evaluated. This culture shift may take a while. • When teachers are evaluated they tend to play safe – they teach lessons that they know will go well. Lesson studies are different. Teachers take risks. They want to find out or try something new and learn from this. • In lesson study, teachers plan lessons collaboratively and have joint ownership over the lesson, they are not held personally responsible for them. • In lesson study, the focus of observers' attention is on the learning of students, not on the teacher's performance.

[2] Lewis, C., & Hurd, J. (2011). *Lesson Study step by step: How teacher learning communities improve instruction*. Portsmouth, NH: Heinemann.

Students won't behave typically with so many people watching.	• We are not trying to find out what happens in an average lesson, we are trying to study student learning. Students may behave differently and indeed discipline issues may not arise, but that is a good thing. We want to study how students can be helped to learn mathematics, not behavior management. • Observers do not interact with students while observing, as this would disrupt their thinking.
We do lesson study already. We often go into a colleague's lesson and watch each other teach. What's new?	• There has been a tendency to label all kinds of lesson observation as "Lesson Study". Here we are defining Lesson Study as the complete process: identifying a research focus, planning, teaching, analyzing, reviewing. If these are not *all* present, we don't call it "Lesson Study". This type is rare in the western world, but common in Japan.
How do I find a good research focus for a lesson study?	• A research focus usually starts with a question like: How can I help my students move in their understanding from X to Y? It may concern conceptual development (e.g. moving from additive to multiplicative reasoning), or it may be the development of a mathematical practice (e.g. moving from describing to critiquing reasoning). Some suggested research questions are given on Slide 11 of the presentation.

ACTIVITY SEQUENCE

Title Slide

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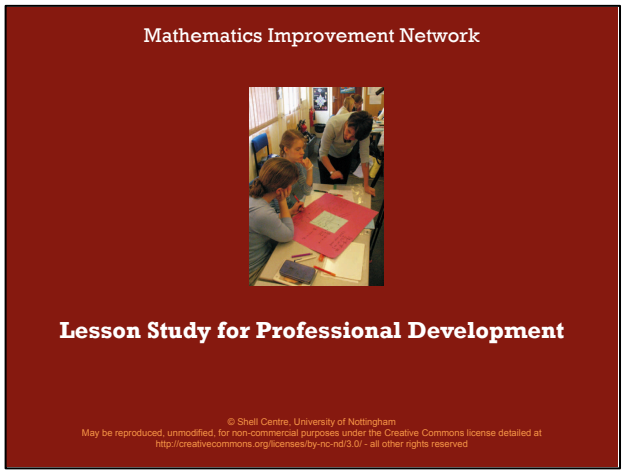
Slide 1



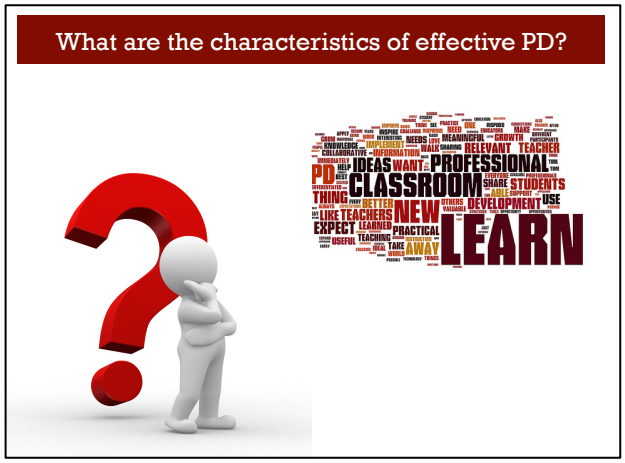
Introduction

Ask participants to reflect on the professional development they have experienced using **Handout 1.** (5 minutes)

- What has been the most helpful and effective professional development you have undertaken?
- What made it so effective?
- List some of the characteristics of effective PD.

Share your answers with your neighbor.

Slide 2

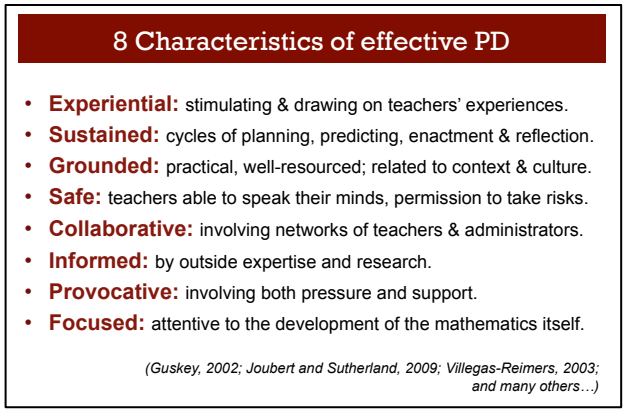


This list provides eight characteristics of effective PD suggested by research.

It appears that PD is most effective when it is based on prior experience, takes place over an extended period, when it involves teachers in planning together, predicting and enacting plans, then reflecting on outcomes. PD should enable teachers to take risks and try out new ideas collaboratively, without fear. It should be informed by outside expertise and research, be challenging and focused on the development of mathematics.

- How many of these factors did you consider?
- Can you think of any more?

Slide 3



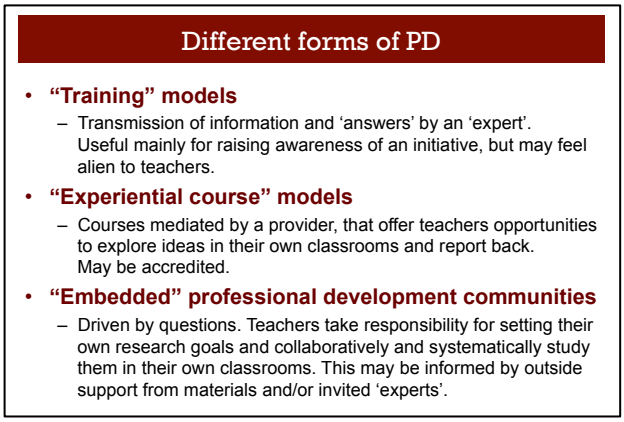
Three forms of PD are very common.

Training models are usually one-off events. An 'expert' 'delivers' a lecture, everyone discusses it and then departs. This can raise awareness about an issue, but it's not effective for deeper changes.

Experiential courses that run over extended periods can be very effective, if they follow the principles discussed above.

But the most powerful PD takes place in **embedded professional communities**. Here a community of teachers works together over time to tackle issues that are held in common. The community may call on outside expertise to assist, but the agenda is owned and shared by the community.

Slide 4

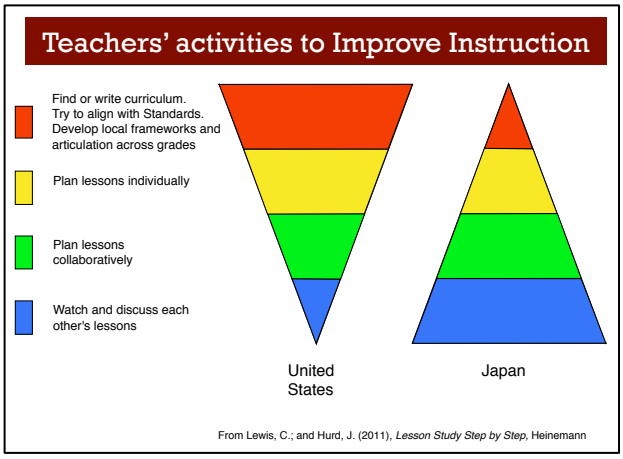


A striking example of an embedded model of professional development is Lesson Study as it is commonly practiced in Japan. Lesson Study in Japan is effective because it is rooted in the observation and discussion of classroom practice.

This is rare in the US. This diagram schematically compares the relative time spent on instructional improvement activities in the US and Japan.

"Many factors conspire to keep US teachers in the top layer of the triangle…. Although these may be needed activities, they do not reveal what actually happens in classrooms. The triangle of US instructional improvement thus stands precariously on its tip; we are trying to improve instruction without actually observing and discussing it."[3]

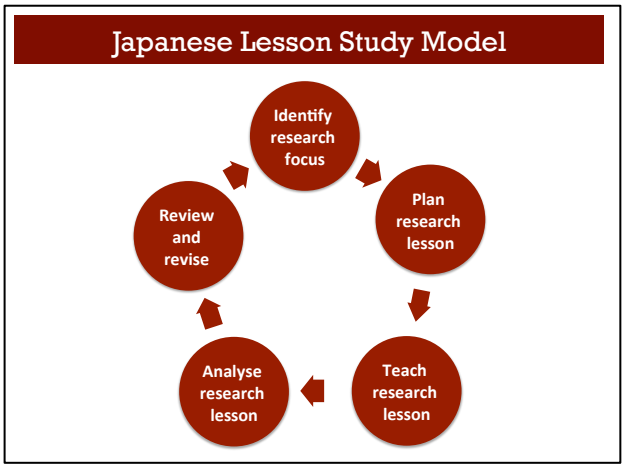
Slide 5



The Japanese model is illustrated by this diagram:

The community of teachers identifies a research focus. This often takes the form: "How can I help students to understand X?" Then a small group of teachers collaboratively plans a lesson that seeks to answer the question. The lesson is taught and observed by the community, which may involve teachers, students and visitors. After the lesson there is an extended discussion in which the lesson is analysed, and the research question is addressed. Finally the lesson may be reviewed and revised, if this is felt to be necessary. Then the cycle repeats.

Slide 6



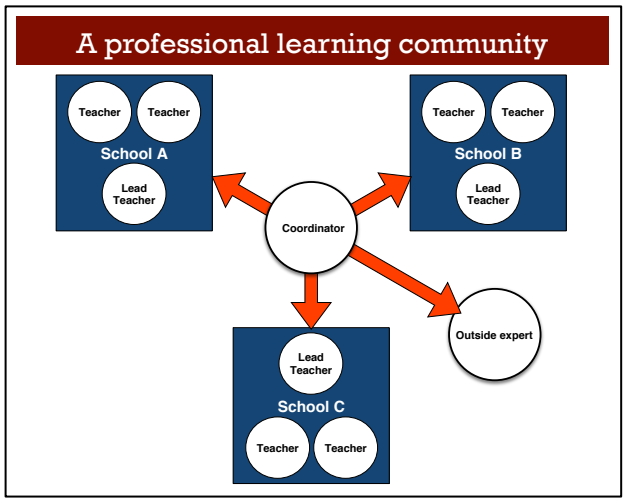
[3] From Lewis, C.; and Hurd, J. (2011), *Lesson Study Step by Step,* Heinemann, page 11.

Professional Learning Communities

This diagram shows one typical example of a Lesson Study community. Of course there are many variations but this seems to work well.

- **The coordinator**. Most successful lesson study groups have a single coordinator. Their role is to identify and invite participants and assign responsibilities.
- **The school cluster**. Here, three schools form a cluster. These are usually neighbouring schools with which the coordinator already has some relationship.
- **A lead teacher**. This is the person who will organise the research lessons within each school. This lead teacher will identify other colleagues that will also take part in the lesson study. So there will be at least three teachers in each school taking part.
- **An outside 'expert'**. This 'expert' should have knowledge of relevant research and work with teachers.

Slide 7

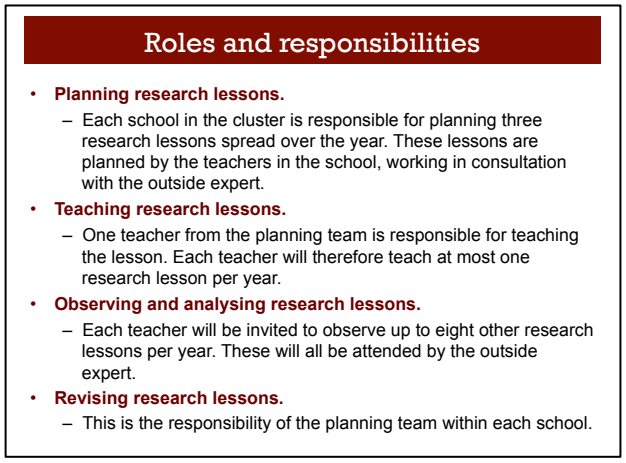


We have found that if each school plans about 3 research lessons over a year, then this provides them with enough time to plan the lessons well. Any more than this, we find that the planning is too rushed.

Teachers within each school collaborate on planning the lesson, so the responsibility is shared. The normal class teacher will teach the lesson.

This means that within the cluster, each teacher will have the opportunity to teach one research lesson and observe up to 8 others each year.

Slide 8



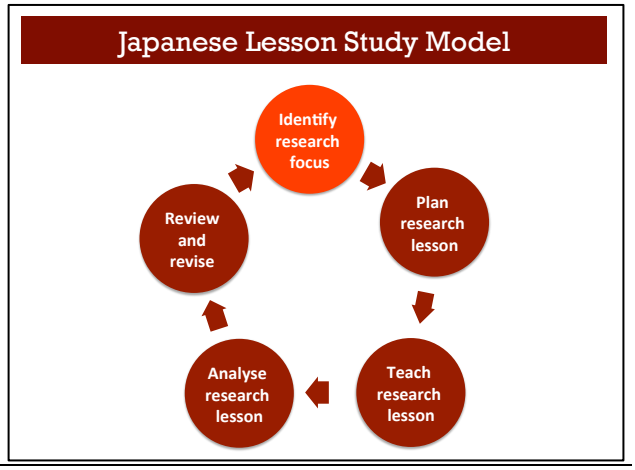
The research focus

Lets consider the phases of Lesson Study, one at a time.

After describing the phase in general we shall look at a particular example using a Lesson Study on problem solving that took place in the UK.

The first phase involves identifying the research focus.

Slide 9

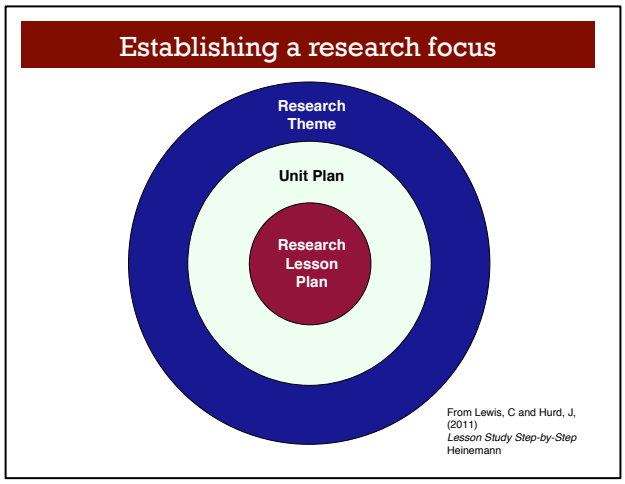


The Research focus sits within a broader **research theme**. This may be a whole-school or departmentally agreed theme. For example, we may want students to develop their ability to tackle unstructured problems; or to be less dependent and more self-regulated.

Then we consider the **Unit Plan**. This shows the development of the mathematics for the sequence of lessons that lead up to and include the research lesson. This might for example, involve analysing students' prior experiences with tackling unstructured problems.

Finally, we come to the **Research lesson plan** itself. What will be the research focus of this particular lesson?

Slide 10



In the particular case study we will use for this workshop, the teachers have chosen the research theme of improving students' capacity to tackle unstructured problems from the real world.

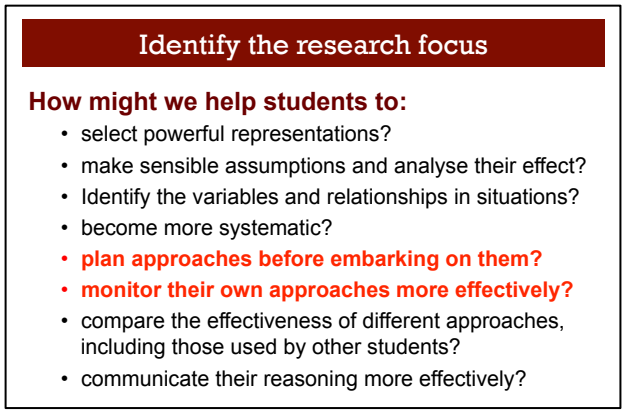
Here is a list of more specific themes they could consider for the lesson. Their choice of task for the lesson will depend on which of these they choose.

In our case study, however they chose the two research questions highlighted in red.

The process of choosing an appropriate research question takes time and should not be skipped. It may take one or two meetings.

- What would be a suitable research question for a class you teach?

Slide 11



The lesson plan

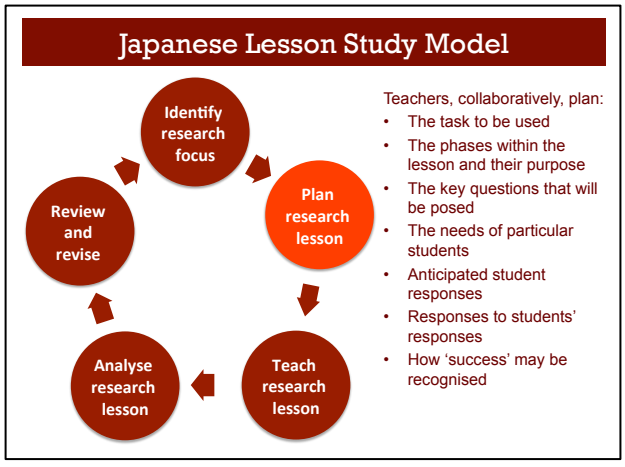
Teachers devise the plan collaboratively.

Of course the choice of task is crucial. After this we devise the structure of the lesson and the key questions that will be asked. We anticipate how students will respond to these and plan interventions.

We have found it helpful to plan with particular students in mind – perhaps one that excels in maths and one that struggles.

And finally, we try to define how we might recognise progress and success in achieving our aims for the lesson. There is a lot to do!

Slide 12



How do we choose an appropriate task for the lesson? It is helpful if the lesson does contain one main problem or concept, and is not fragmented.

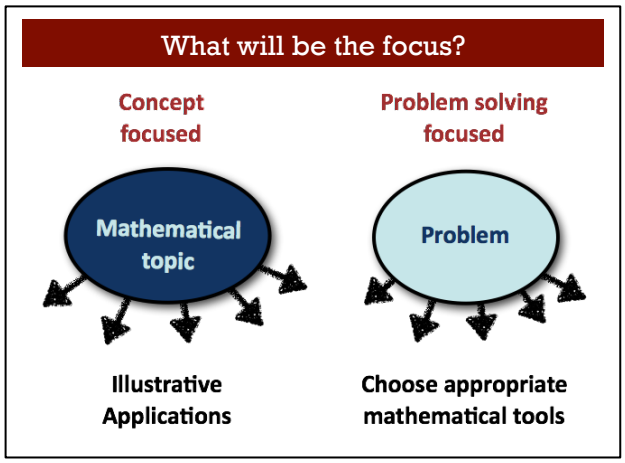
It is important to decide if the lesson is going to focus mainly on the development of a mathematical concept or mainly on solving a problem.

If the purpose is related to the development of a topic, like solving algebraic equations, then students will know that they have to solve the problem by creating an equation. The problems chosen for the lesson will be illustrative applications of this idea.

If the purpose is to enable students to develop the ability to tackle non-routine problems, then students are free to select the mathematical tools to use. They may choose equations, or they may choose a different approach (e.g. numerical or graphical).

In the example we will consider, the purpose is problem-centred, rather than topic-centred.

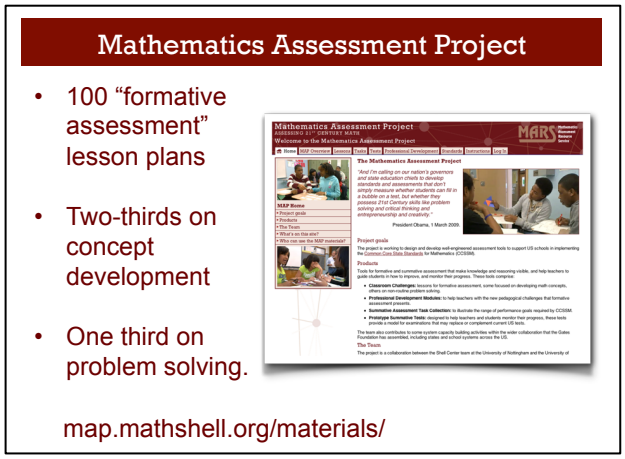
Slide 13



So where might we get ideas for tasks for lesson study? The Mathematics Assessment Project has both types of lessons; concept-focused and problem-focused in about the ratio 2:1. These contain extensive, well-researched lesson plans that can form the basis for developing a lesson study.

These plans will still need to be adapted to suit the research question and the particular students. But you do need to have good reasons for making any adaptations – these lessons have been developed with great care.

Slide 14



Next we have to plan the structure of the lesson.

This slide shows the Japanese way of designing lessons.

Notice how students are given the chance to tackle problems individually before sharing ideas and working collaboratively.

In the *Neriage* phase of the lesson, the teacher carefully selects examples of student reasoning to share with the whole class and students are given opportunities to critique them.

Finally, the teacher summarises the main important ideas from the lesson.

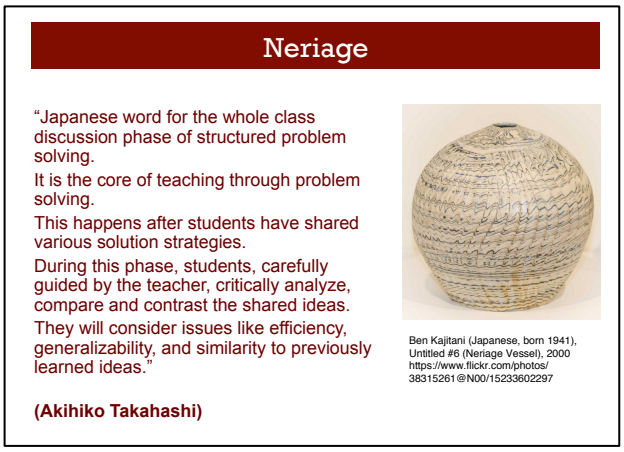
Slide 15

The Neriage phase of the lesson is considered by the Japanese to be the most important phase.

The word Neriage refers back to the ancient Japanese technique of layering, cutting and recombining different colours of clay, creating an intricate pattern.

In a similar way the teacher tries to take and blend the ideas of the class together.

Slide 16



So let's now consider a particular Lesson Study.

The task chosen for the study is provided in **Handout 1.**

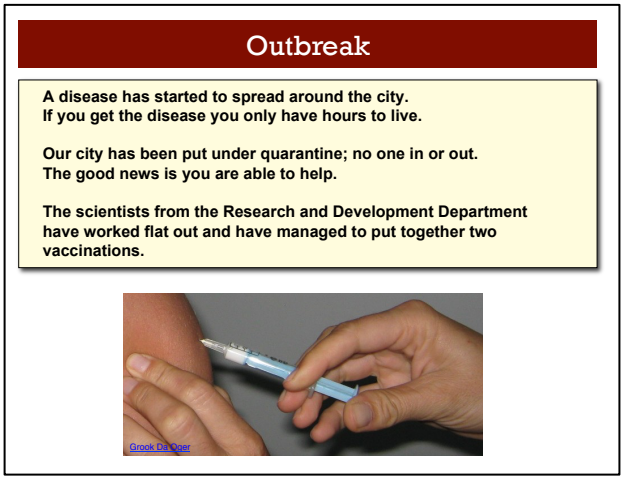
Introduce the task by going through the sequence of three slides carefully.

This first slide introduces the context.

The city is "somewhere in England".

Notice that in this task, the students are taking on a role. They are going to be the decision-makers.

Slide 17

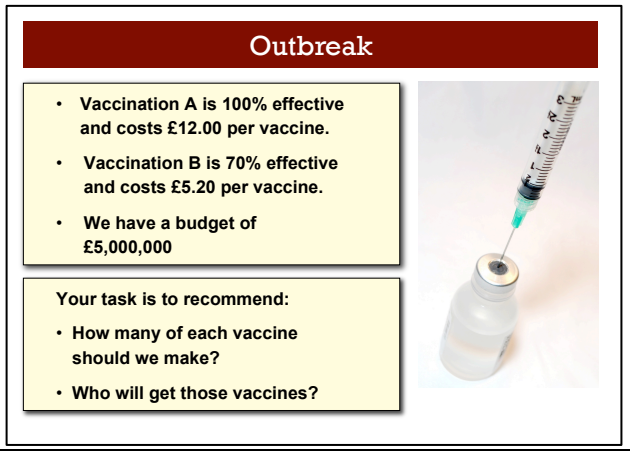


This is the main statement of the task. It's clearly an optimisation task.

How are we going to allocate the resources within a limited budget?

The final question asks students to decide who will get the vaccines. The structure of the city's population is shown on the next page.

Slide 18



- Spend some time working on the task.
- Try to find all the different ways in which this task may be tackled.

Allow participants 15 minutes to work on the task.

Slide 19

Occupation	Number in population
Medical workers (doctors, nurses)	75600
Key service workers (electricity, refuse)	113000
Food shop personnel	113000
Farmers and food producers	85100
Other shop workers	104000
Other professionals.... teachers, lawyers, etc.	123000
Other trades people: decorators, plumbers, mechanics, etc.	85100
Retired people	86400
Students and school students	94600
Children under 5	66200
Total	946000

Now give out the lesson plan. **Handout 2.** *This is a fairly length document.*

This is the full lesson plan surrounding the task that was developed by the three teachers in our case study.

It took about 3 months to develop by the teachers.

This was done collaboratively, with the help of the 'outside expert'.

We will go through this together. This might help you see what the planning process involves.

First, I want to draw your attention to two aspects of this plan, the **anticipated issues table**, and the **progression grid**. (Pages P-4 and P-5)

Slide 20

First, the teachers decided that they didn't really know how the students would tackle the task in the research lesson.

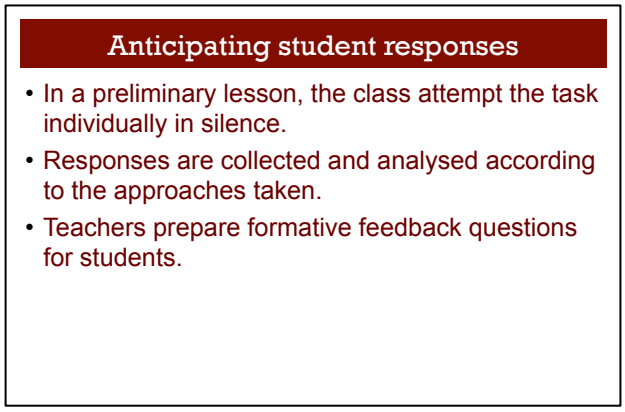
So, they decided to give the task to the class before the research lesson and to let the students have an initial attempt at the task, individually.

The teachers were then able to go through the student responses and analyse the difficulties that students were having.

They then prepared questions that would help students overcome these difficulties.

- What difficulties would you anticipate that *your* students would have with this task?

Slide 21



This slide shows the teachers' summary of the difficulties students were having. It's quite a formidable list!

Some students just leapt in and began calculating the costs of vaccinating those at the top of the list – the medical workers. Others jumped to conclusions: "Vaccine A is more effective so just use that".

Others didn't grasp the meaning of words like "Vaccination B is 70% effective". They thought that this must mean that exactly 70% would survive!

Some got confused by the large numbers and even added people to money!

Slide 22

Anticipated issues

Students:

- started with detailed calculations before planning:
- ignored constraints.
- did not justify the decisions they made.
- jumped to conclusions:
- didn't understand the concept of a budget
- Were overwhelmed by the large numbers
- didn't grasp meaning of calculations
- didn't understand "effectiveness" of each vaccination:
- became confused between numbers representing money and people.

Next to each of these issues, teachers planned an appropriate response using the anticipated issues table. Part of it is shown here.

Briefly show this slide and refer people to the lesson plan. Don't read the slide out!

Slide 23

Key Issue	Suggested questions or prompts
Students start detailed calculations before planning an approach	• Describe in words a plan for tackling this problem. • What are the key decisions you have to make? • Which information are you going to focus on at the start, which will you ignore?
Students ignore one or more constraints.	• Do you have enough resources for your solution? • Have you made enough vaccine for everyone? • Have you wasted any money? • Have you wasted any vaccine?
Students do not justify decisions made.	• Why have you chosen to allocate the vaccines in this way? • How can you be sure this is the best solution?
Students leap to conclusions	• Have you taken all the issues into account? • Could you vaccinate more people if you used some of vaccine B? • Could you save more lives if you used more of vaccine A?

The teachers also discussed how they would recognise progress on their two research foci.

Remember that these were:

How can we enable students to:

- plan strategically and
- monitor their approaches more effectively?

They therefore produced this chart to show the characteristics of responses at four levels: little progress, some progress, substantial progress and task accomplished.

They then prepared some questions that they thought would help move students from one level to the next.

Slide 24

	Strategic planning	Monitoring work
Little progress	Carries out operations with figures but shows little strategic awareness that will lead to a solution.	Carries out calculations without stopping to reflect or think about what is being achieved or alternative approaches.
Questions	*Can you write a plan for completing the task? What other information must you consider?*	*When you have finished this calculation, what will you do next? How will you organise your work?*
Some progress	Carries out appropriate and correct calculations but does not take constraints into account.	Considers alternative approaches by comparing own method with others, but this has no impact on own approach.
Questions	*Are there other pieces of information you have not thought about?*	*What ideas does your partner's work contain that may help?*
Substantial progress	Works towards a solution logically reaching a viable solution	Considers the work of others. Compares approaches and uses them. Finds it difficult to discriminate efficient/ inefficient approaches.
Questions	*Can you think of another method? What be the effect on the outcome?*	*Which idea is more powerful? Which method would work with different numbers?*
Task accomplished	Arrives at a solution having considered alternatives.	Engages thoughtfully with the work of others. Selects and uses powerful approaches.

Now we come to the lesson plan itself.

The teachers decided that discussion would be enhanced if students sat next to someone that had a different approach.

After a brief introduction, students would be asked to read their partner's initial ideas and comment.

They then would be asked to work with their partner to produce a new joint solution.

Then some examples of student work would be discussed publicly.

This would lead to a further refinement of students' own ideas before a final plenary discussion and reflection on what had been learned.

That's the plan! We'll see what happened in a moment.

Slide 25

Lesson Plan

- Seating plan changes
- Re-introducing the lesson
- Looking at partner's work (Green sheet)
- Collaboration in pairs for a new approach
- Whole class discussion
- Redrafting their approaches
- Summarizing and reflecting

The teachers decided to produce a Green sheet to structure students' comments on each others' work.

This was one important way in which they hoped to help students to plan strategically.

Slide 26

Green sheet to encourage monitoring

Analysing Partner's work

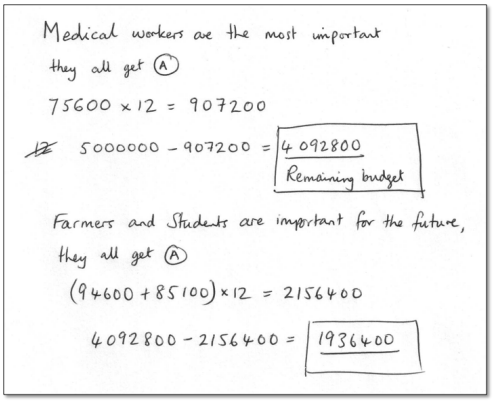
1. Describe briefly what your partner has done.
2. Why do you think they have done this?
3. How is this different from your approach?
4. What impact will this have on your next attempt at the problem?

They also produced two pieces of work to support the whole class discussion. These were based on the two main approaches students had shown in their preliminary work.

One approach begins by allocating the best vaccine to the most important group of people. Then they check to see how much money is left. Then they allocate to the next most important….

Slide 27

Using Sample Student Work



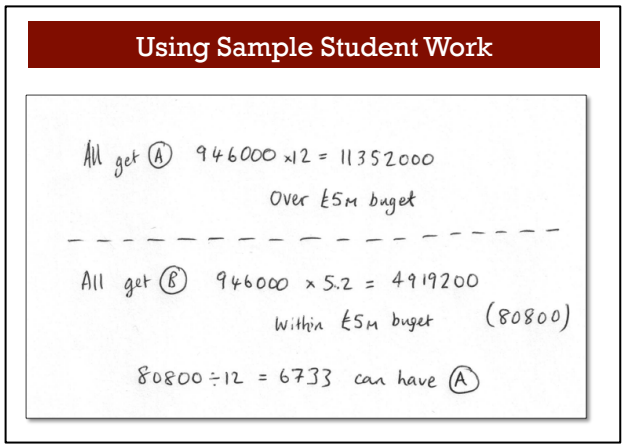
The other approach starts by deciding how much it will cost to vaccinate everyone with vaccine A. This takes them over budget. They then see if they can afford to give everyone B. This can be afforded, so they see how much is left.

This approach is different to the first as they start by ignoring the types of people that will get the vaccine, they work out how many can be afforded. Later, they can work out who gets what.

- Which of these two approaches is best?

The lesson plan is circulated to all the observers well before the research lesson.

Slide 28



Teaching the research lesson

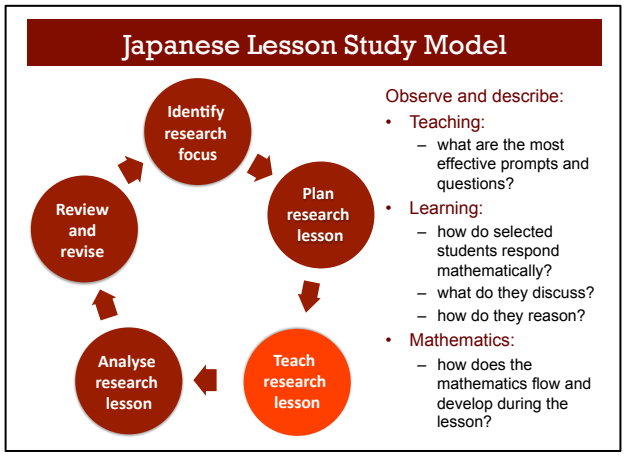
We now come to the next phase in the cycle: teaching and observing the research lesson.

On the day of the research lesson, all the observers arrive for a pre-lesson briefing.

In this short meeting, the teacher describes the school context, the class, and the main purpose of the research lesson. He or she reminds the observers of the research focus, and instructs them on what aspects of the lesson to look at more closely.

We are now going to see a small part of that briefing.

Slide 29



Watch the clip together (2 minutes 45 seconds).

The class have already worked on the task individually, for two 15 minute periods (using different figures). This helped the teacher plan this research lesson.

So lets now look at the lesson.

Slide 30

As you watch, use **Handout 4** to make notes on these two questions.

This handout provides a table showing the structure of the lesson. Make notes next to the relevant parts of the lesson.

Slide 31

As you observe the lesson make notes:

What evidence can you see of:

- Students planning the work they will do next?
- Students monitoring their solution approach as they work?

What teaching strategies help?

Now watch the lesson. This takes 15 minutes.

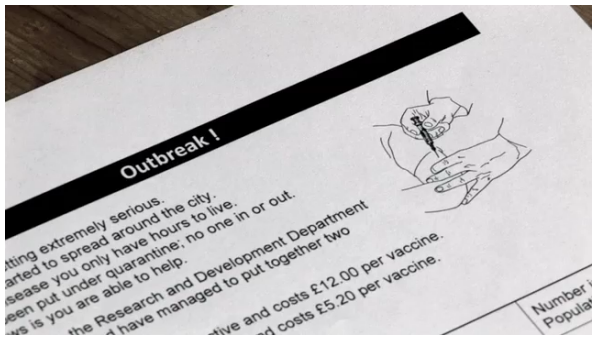
Afterwards, go back to slide 31 and ask participants to spend 2 minutes writing down their thoughts individually, then to discuss these thoughts in pairs.

Try to keep your discussion to these questions.

- What evidence did you see of students planning and monitoring?
- What teaching strategies helped?

Slide 32

The Lesson



Now ask participants to share a few of their ideas with everyone.

This slide shows the overall structure for the lesson.

- Which parts of this structure were most powerful for students do you think?

Slide 33

Summary of lesson structure

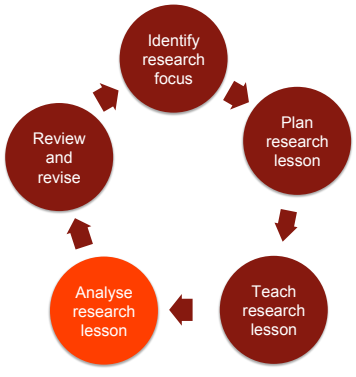
1. Recall the task
2. Review the task in silence.
3. Clarify the purpose of the task
4. Interpret and explain your partner's work
5. Produce a joint solution
6. Review the purpose of the task
7. Two pairs present solutions to the class
8. Plan for next time

Analysing the research lesson

We now come to the post lesson discussion. You have already been experiencing something like this!

Slide 34

Japanese Lesson Study Model



The post-lesson discussion usually occurs immediately after the lesson in the same classroom, so that students' work is available.

The discussion should be chaired carefully, so that the discussion doesn't wander from the main purpose of the lesson study.

At the end of the discussion, the Japanese approach is to have the 'external expert' or the 'commentator' relate the discussion to research and look at the implications of the lesson study for future work.

Slide 35

The post-lesson discussion

- Same day debriefing includes a facilitator, the teacher, observers, a commentator (koshi).
- Teacher describes the lesson; reasons behind decisions made; departures from the plan.
- Observers describe what they saw in the target students. Discussion focuses on the research question.
- Commentator relates observations to research and discusses implications for future.

The post-lesson discussion to our lesson took about 90 minutes and ranged over many things.

We will here show just two short extracts concerned with the research question:

How can we enable students to:

- plan strategically and
- monitor their approaches more effectively?

Slide 36

Green sheet to encourage monitoring

Analysing Partner's work

1. Describe briefly what your partner has done.
2. Why do you think they have done this?
3. How is this different from your approach?
4. What impact will this have on your next attempt at the problem?

The first extract concerns the impact of the green sheet on students' planning.

Watch the extract together. (2 minutes 51 seconds)

- Do you agree that interpreting each others' work using the 'green sheet' encourages planning behaviours?

Slide 37

Planning fostered by interpreting each others' work

The second extract begins with the teacher explaining why he chose the two pieces of student work to be presented. This then leads to a discussion about the two strategies.

Watch the extract together (3 minutes 19 seconds)

- Do you agree that one approach was 'mathematically better' than the other?
- What do you think about the 'moral aspects' of the problem. How did the 'moral approach' encourage students to self – monitor their approaches?

Slide 38

Now we shall see and extract from the concluding comments by the 'external expert' (or the 'Koshi', as this role is known in Japan).

In this case this role was taken by a university professor, Malcolm Swan.

In the extract we see, he refers again to the green sheet and relates it to some work by Professor Alan Schoenfeld at Berkeley.

Watch the extract together. (2 minutes 48 seconds)

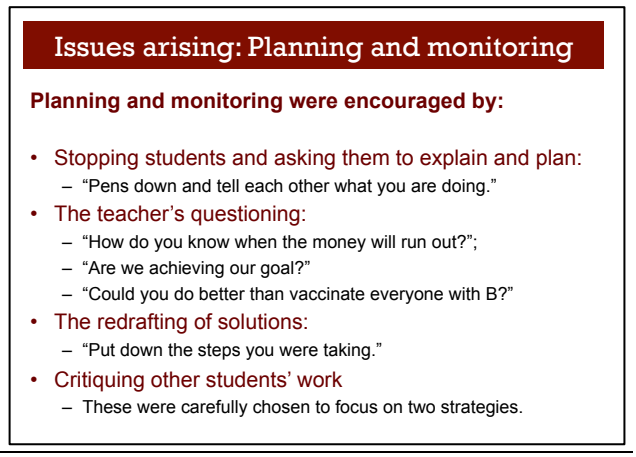
- What other aspects of the lesson do you think these teachers could build into their everyday practice?

Slide 39

This slide describes a few of the ways that the "Koshi" noticed the teacher encouarging planning and monitoring throughout the lesson.

After each of these interventions, students began to plan and think about what they would do next.

Slide 40



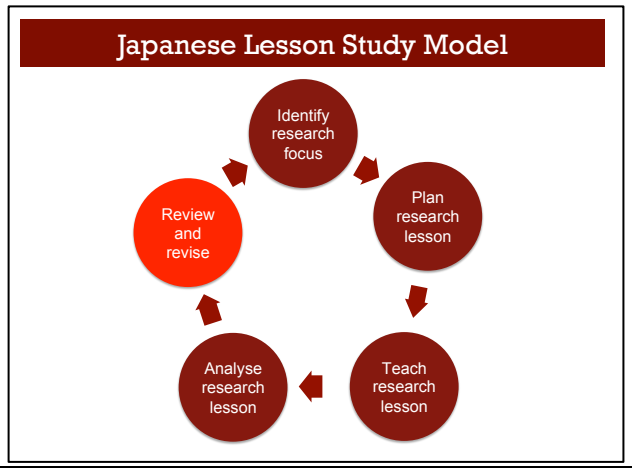
Reviewing and revising

Finally, we come to the last phase of Lesson Study.

Strictly speaking this part is not always necessary, as the main goal has by now been achieved: participants have all learned and developed professionally.

However, it is often the case that in the light of the study, participants want to review the lesson plan and try to improve it.

Slide 41



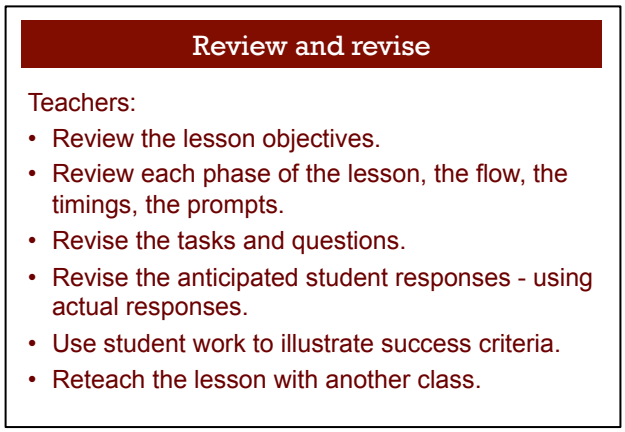
Here are some of the things they often reflect on.

Reteaching the lesson is always revealing. No two classes are the same and new insights will be gained.

However it should be said that the goal of lesson study is not the creation of a perfect lesson plan – even if there were such a thing, but that everyone learns something new.

So lets leave the last word to the teachers.

Slide 42



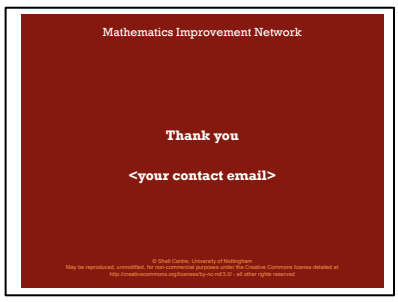
Play the extract. (2 minutes 27 seconds)

Slide 43

Thank you

Customize the final slide with your own contact details.

Slide 44



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This is a draft version of this session – a revised version should be available Q2 2017.