Mathematics Improvement Network

Lesson Study for Professional Development

What are the characteristics of effective PD?

8 Characteristics of effective PD

- **Experiential:** stimulating & drawing on teachers' experiences.
- **Sustained:** cycles of planning, predicting, enactment & reflection.
- **Grounded:** practical, well-resourced; related to context & culture.
- **Safe:** teachers able to speak their minds, permission to take risks.
- **Collaborative:** involving networks of teachers & administrators.
- **Informed:** by outside expertise and research.
- **Provocative:** involving both pressure and support.
- **Focused:** attentive to the development of the mathematics itself.

(Guskey, 2002; Joubert and Sutherland, 2009; Villegas-Reimers, 2003; and many others…)

Different forms of PD

- **"Training" models**
  - Transmission of information and 'answers' by an 'expert'. Useful mainly for raising awareness of an initiative, but may feel alien to teachers.
- **"Experiential course" models**
  - Courses mediated by a provider, that offer teachers opportunities to explore ideas in their own classrooms and report back. May be accredited.
- **"Embedded" professional development communities**
  - Driven by questions. Teachers take responsibility for setting their own research goals and collaboratively and systematically study them in their own classrooms. This may be informed by outside support from materials and/or invited 'experts'.

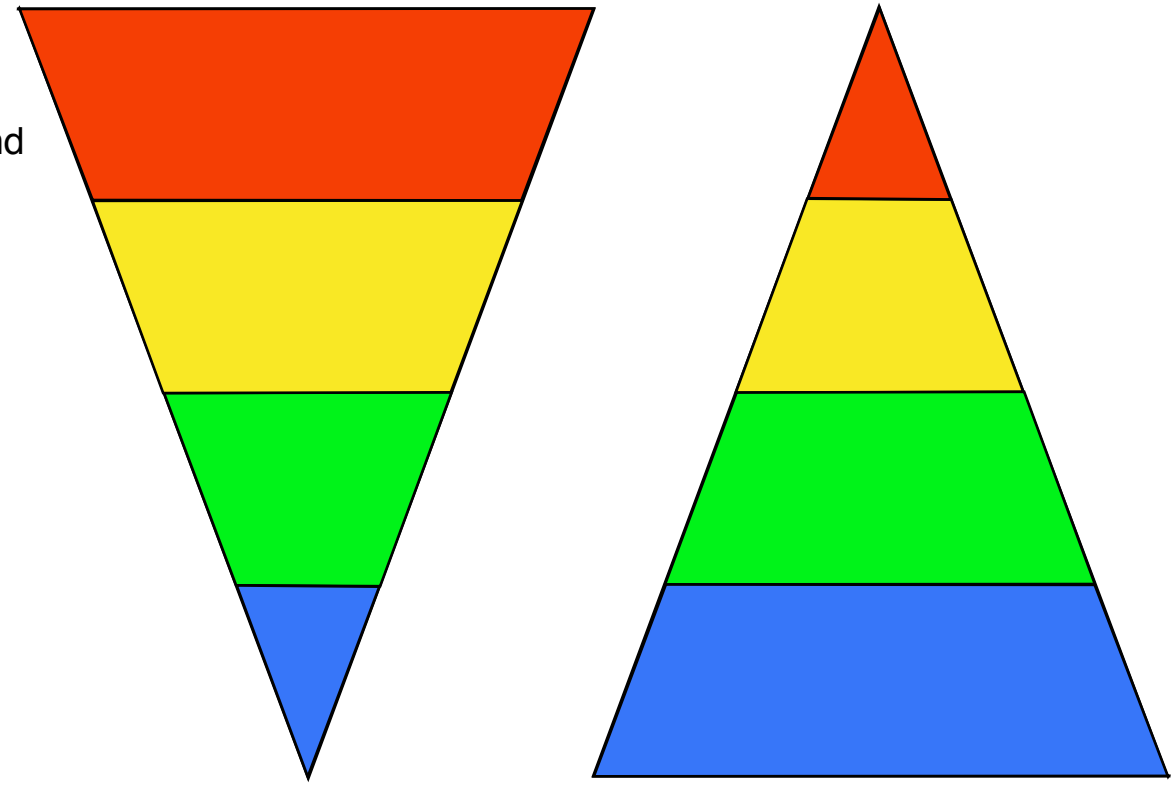
Teachers' activities to Improve Instruction

Find or write curriculum.
Try to align with Standards.
Develop local frameworks and articulation across grades

Plan lessons individually

Plan lessons collaboratively

Watch and discuss each other's lessons

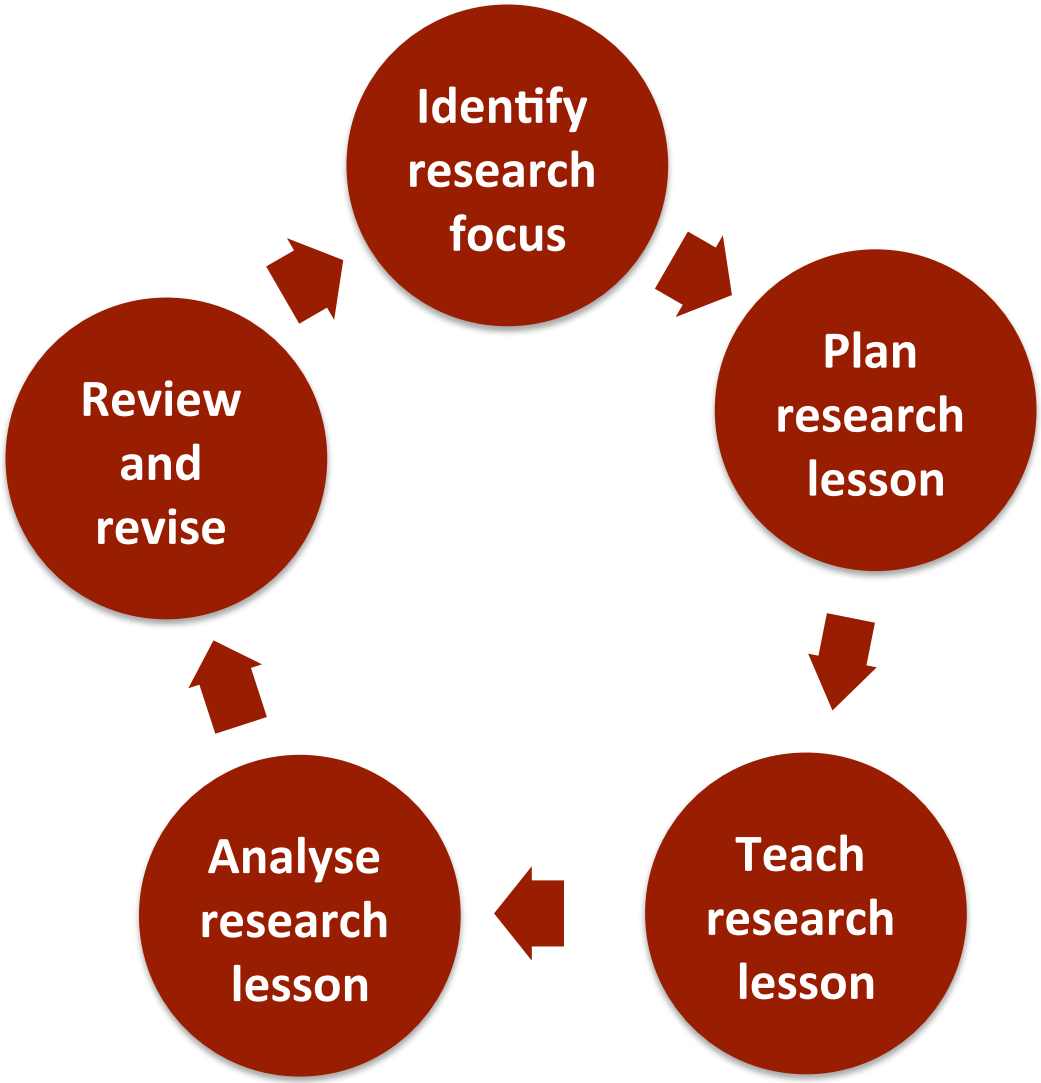


United States

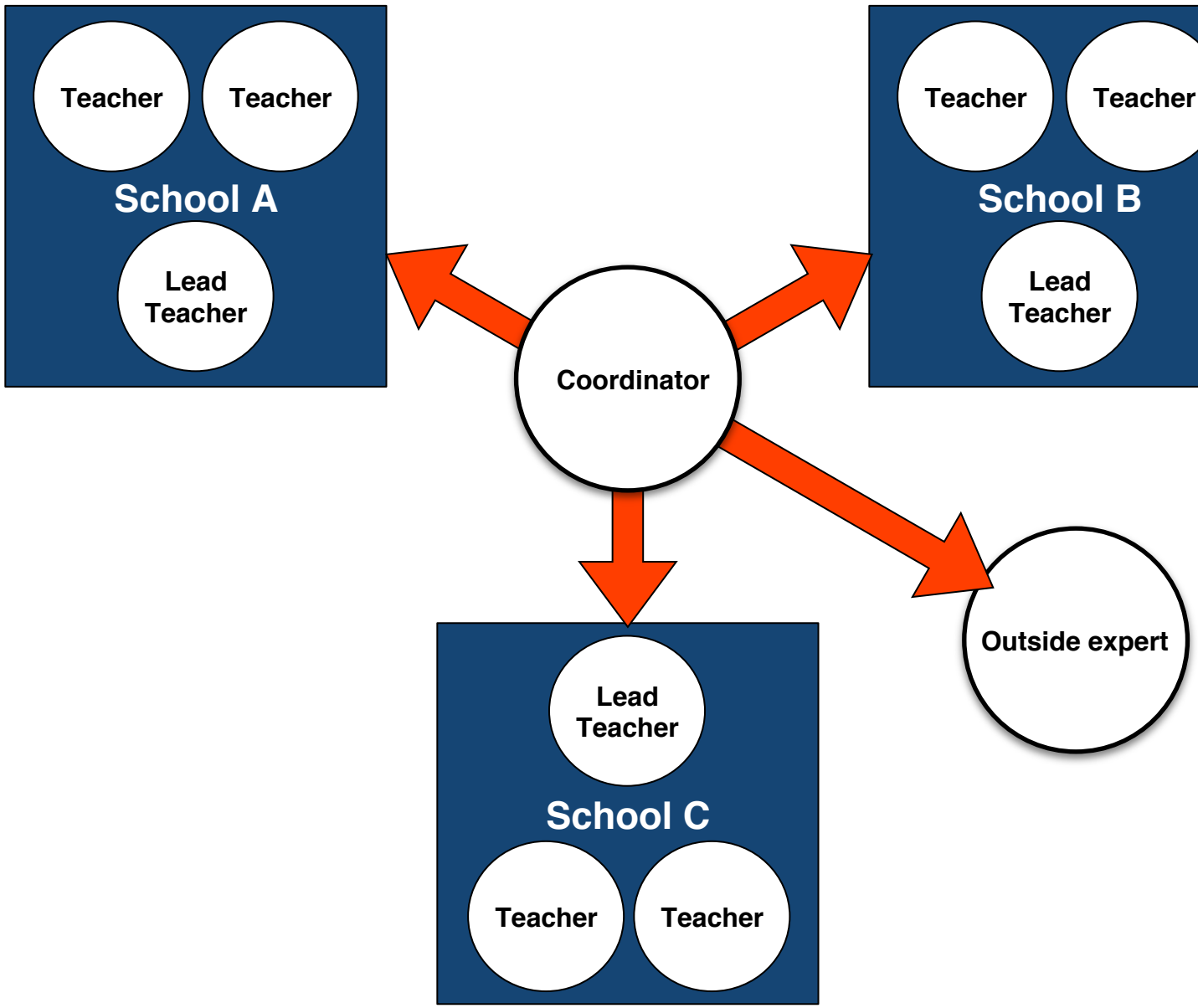
Japan

From Lewis, C.; and Hurd, J. (2011), *Lesson Study Step by Step,* Heinemann

Japanese Lesson Study Model



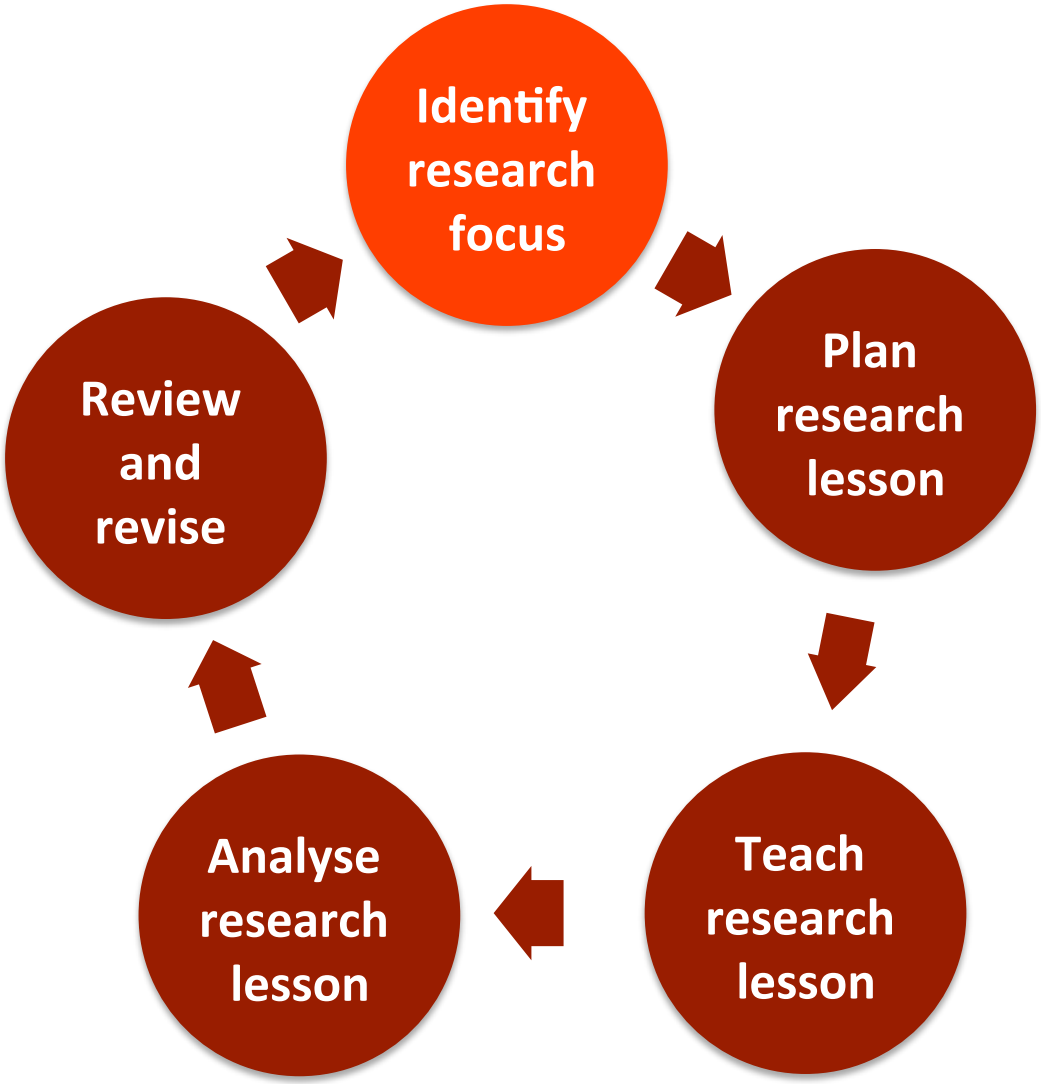
A professional learning community



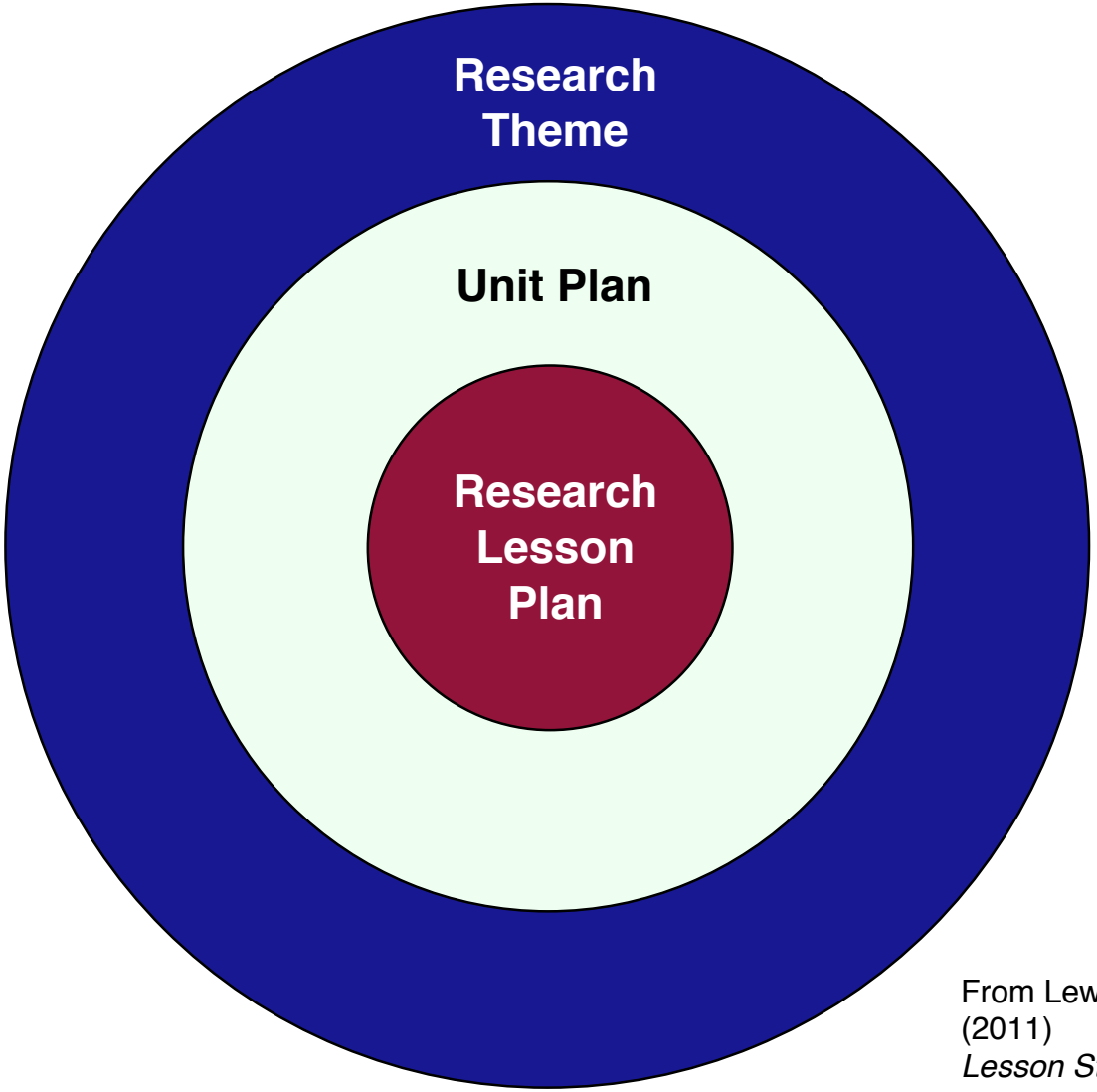
Roles and responsibilities

- **Planning research lessons.**
  - Each school in the cluster is responsible for planning three research lessons spread over the year. These lessons are planned by the teachers in the school, working in consultation with the outside expert.
- **Teaching research lessons.**
  - One teacher from the planning team is responsible for teaching the lesson. Each teacher will therefore teach at most one research lesson per year.
- **Observing and analysing research lessons.**
  - Each teacher will be invited to observe up to eight other research lessons per year. These will all be attended by the outside expert.
- **Revising research lessons.**
  - This is the responsibility of the planning team within each school.

Japanese Lesson Study Model



Establishing a research focus



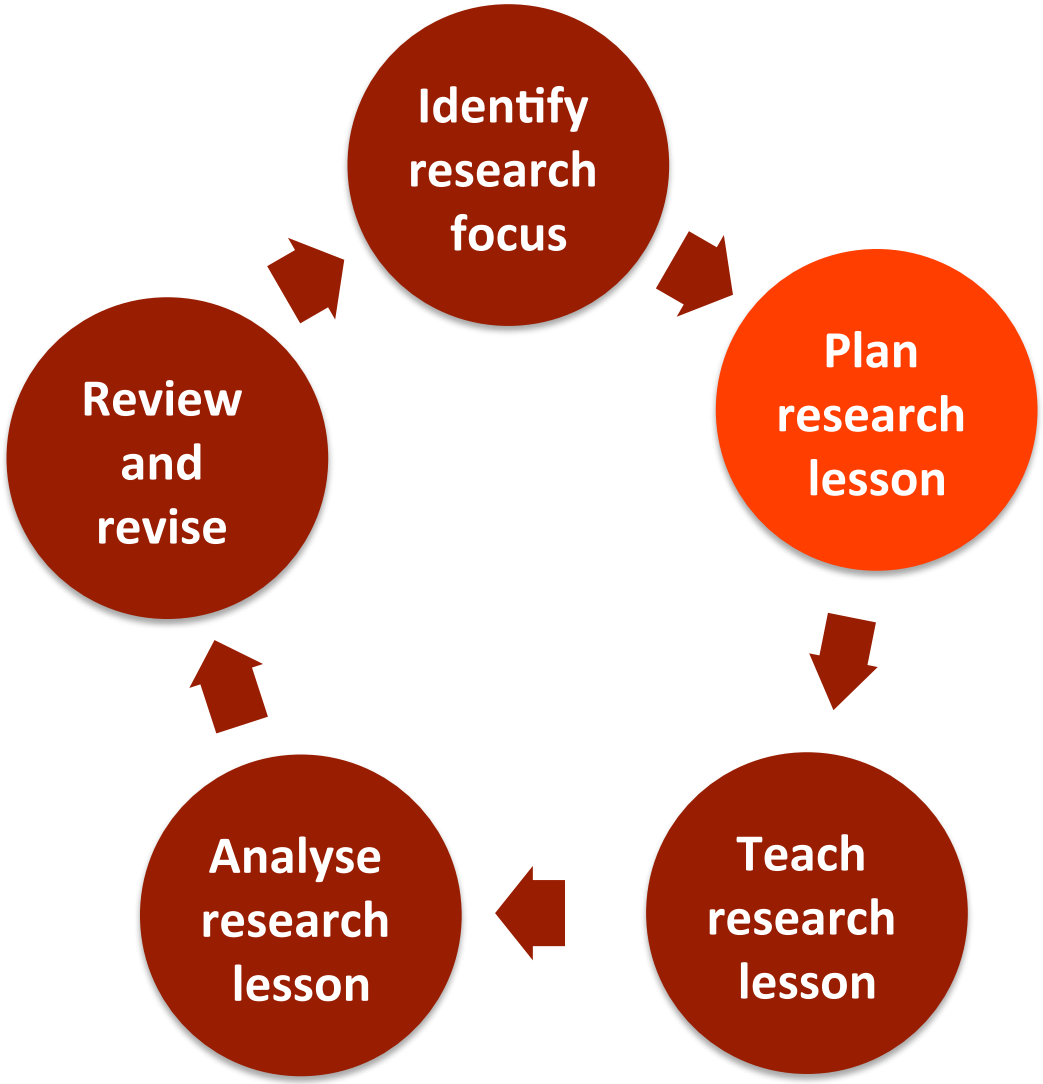
From Lewis, C and Hurd, J, (2011)
Lesson Study Step-by-Step
Heinemann

Identify the research focus

How might we help students to:

- select powerful representations?
- make sensible assumptions and analyse their effect?
- Identify the variables and relationships in situations?
- become more systematic?
- **plan approaches before embarking on them?**
- **monitor their own approaches more effectively?**
- compare the effectiveness of different approaches, including those used by other students?
- communicate their reasoning more effectively?

Japanese Lesson Study Model

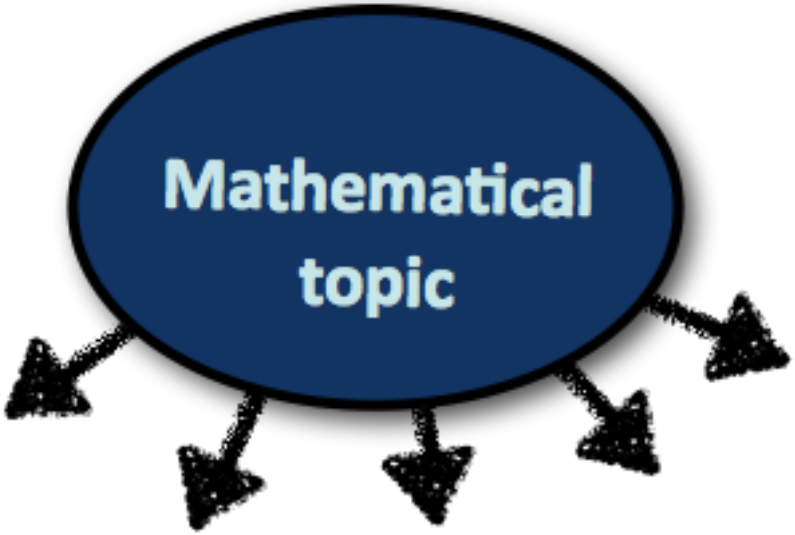


Teachers, collaboratively, plan:

- The task to be used
- The phases within the lesson and their purpose
- The key questions that will be posed
- The needs of particular students
- Anticipated student responses
- Responses to students' responses
- How 'success' may be recognised

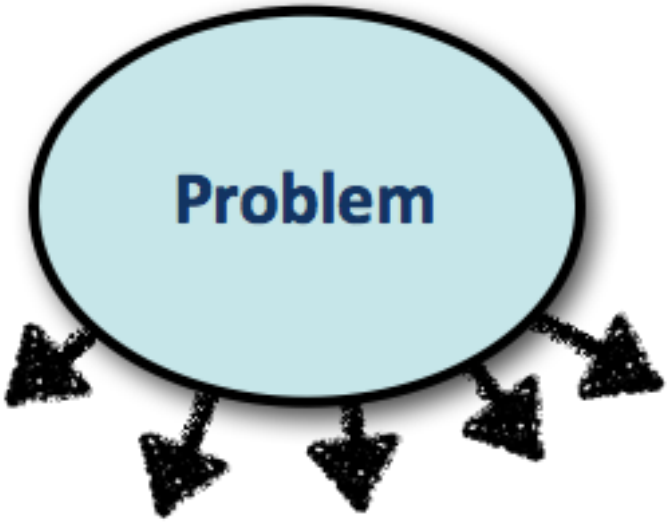
What will be the focus?

Concept focused



Illustrative Applications

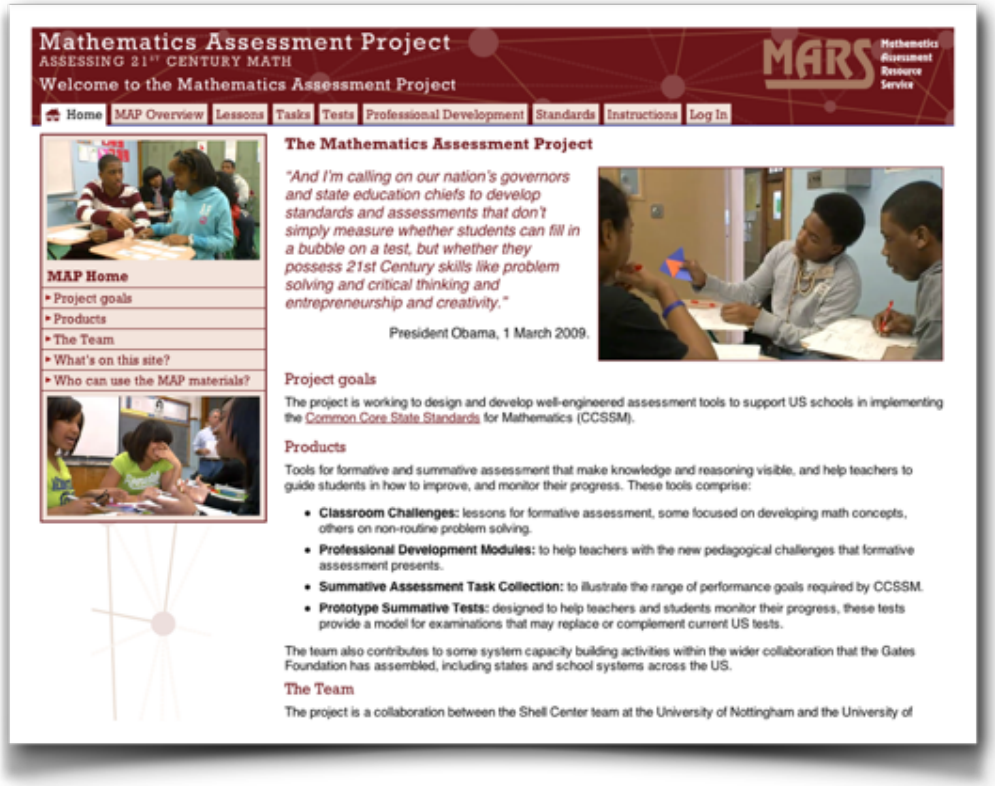
Problem solving focused



Choose appropriate mathematical tools

Mathematics Assessment Project

- 100 “formative assessment” lesson plans
- Two-thirds on concept development
- One third on problem solving.



map.mathshell.org/materials/

Phases of the lesson

Presentation (Hatsumon)

- Teacher presents the problem
- Students discuss the problem

Developing a solution (Kikan-shido)

- Students develop ideas individually
- Students share ideas
- Teacher observes students, makes notes for later

Comparing strategies (Neriage)

- Students share their solution ideas with whole class
- Students critique solutions, identifying strong and weak points.

Summarising and reflecting (Matome)

- Teacher summarises group findings, identifies important ideas, generalises
- Students summarise what they have learned themselves

Neriage

"Japanese word for the whole class discussion phase of structured problem solving.

It is the core of teaching through problem solving.

This happens after students have shared various solution strategies.

During this phase, students, carefully guided by the teacher, critically analyze, compare and contrast the shared ideas.

They will consider issues like efficiency, generalizability, and similarity to previously learned ideas."

(Akihiko Takahashi)

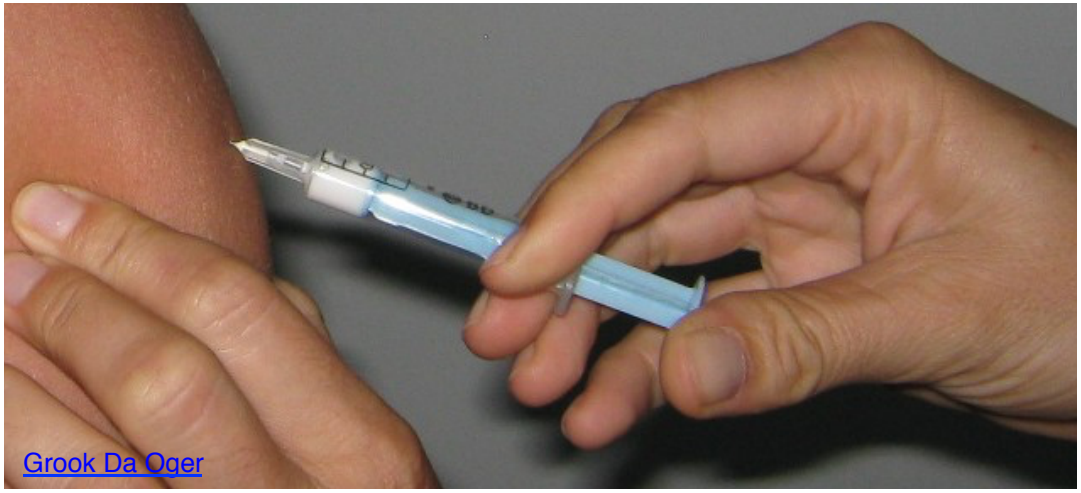
Ben Kajitani (Japanese, born 1941), Untitled #6 (Neriage Vessel), 2000
https://www.flickr.com/photos/38315261@N00/15233602297

Outbreak

A disease has started to spread around the city.
If you get the disease you only have hours to live.

Our city has been put under quarantine; no one in or out.
The good news is you are able to help.

The scientists from the Research and Development Department have worked flat out and have managed to put together two vaccinations.



Outbreak

- **Vaccination A is 100% effective and costs £12.00 per vaccine.**
- **Vaccination B is 70% effective and costs £5.20 per vaccine.**
- **We have a budget of £5,000,000**

Your task is to recommend:

- **How many of each vaccine should we make?**
- **Who will get those vaccines?**

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

Research lesson – lesson plan

Anticipating student responses

- In a preliminary lesson, the class attempt the task individually in silence.
- Responses are collected and analysed according to the approaches taken.
- Teachers prepare formative feedback questions for students.

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.

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?

	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.

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

Green sheet to encourage monitoring

Analysing Partner's work

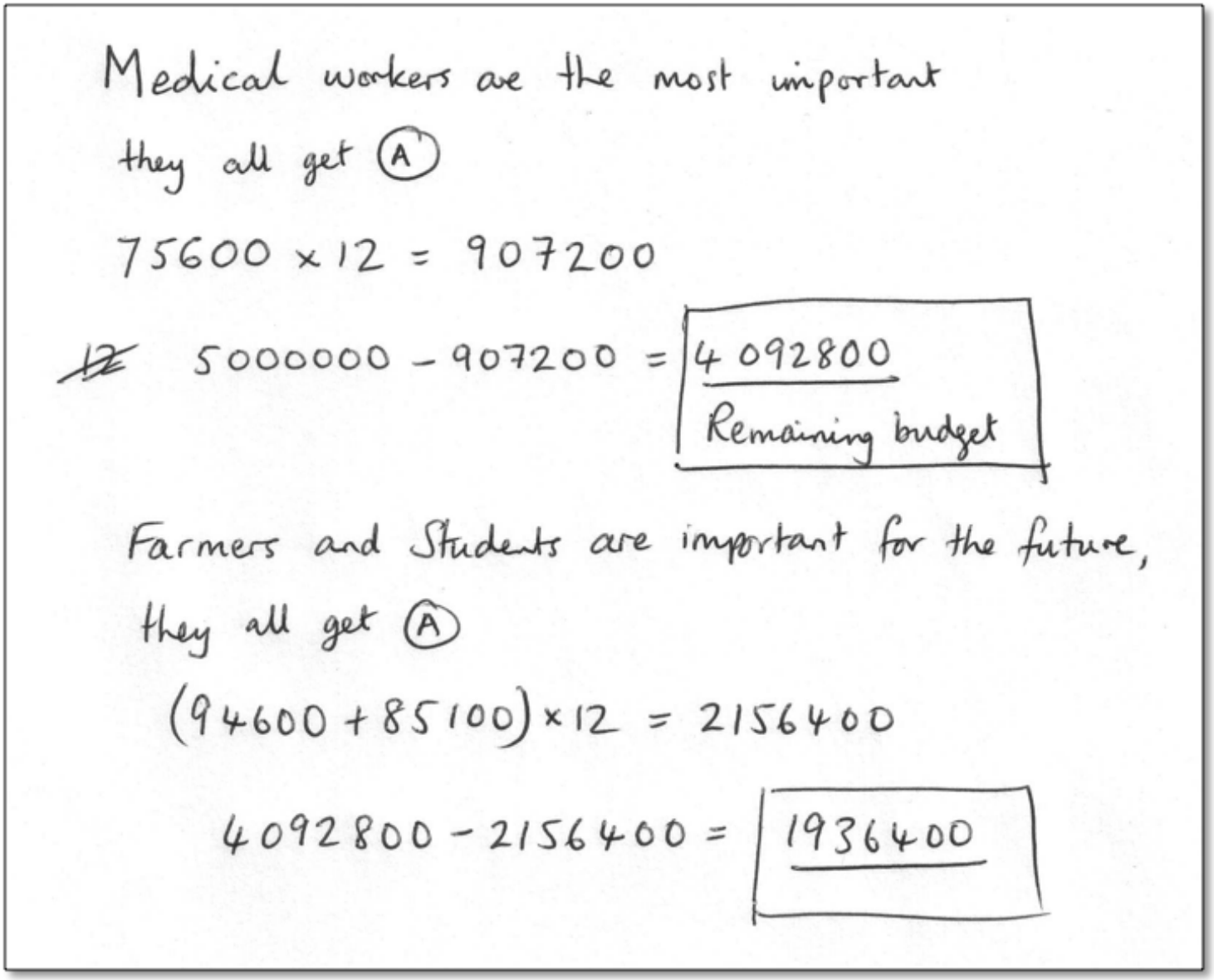
1. Describe briefly what your partner has done.

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?

Using Sample Student Work



Using Sample Student Work

All get (A) 946000 × 12 = 11352000

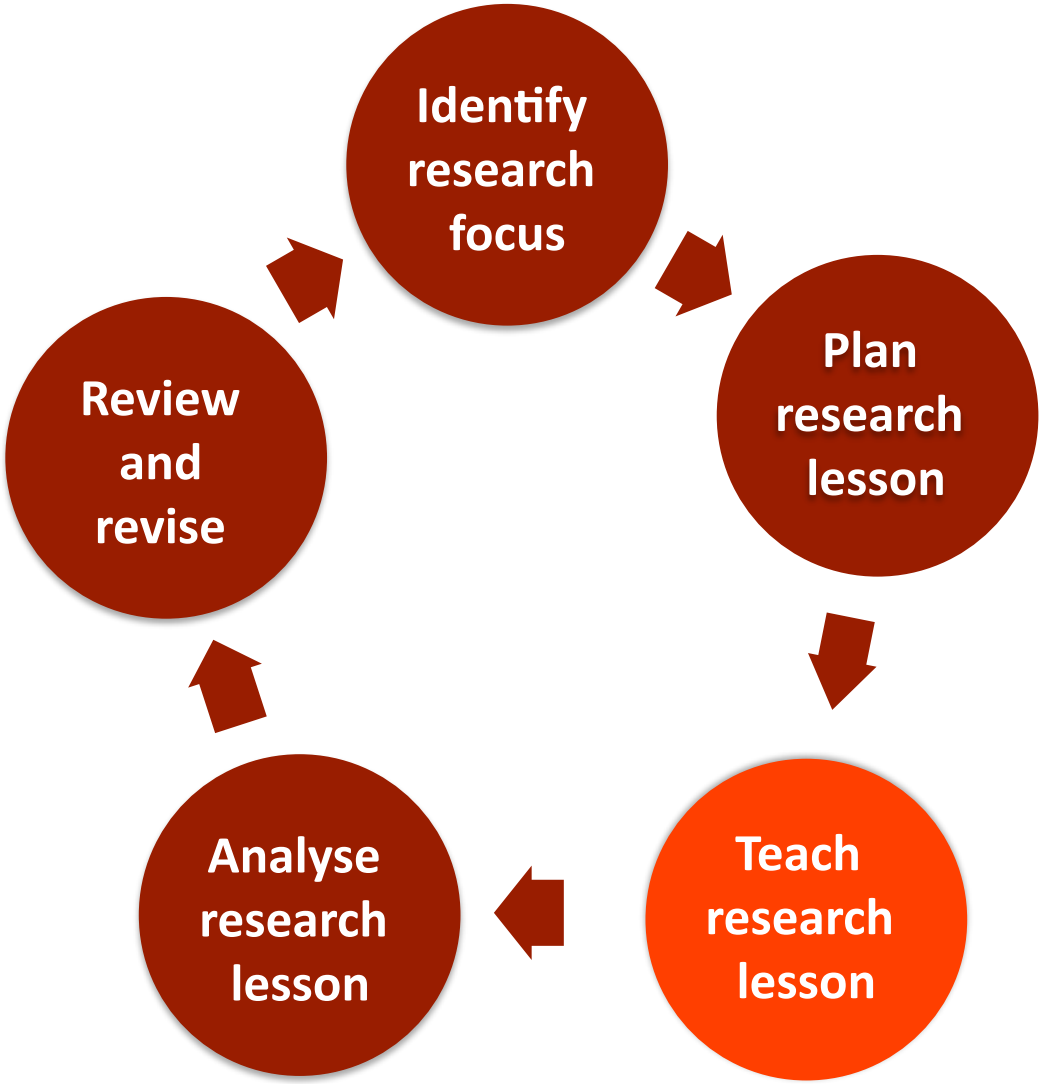
Over £5M buget

All get (B) 946000 × 5.2 = 4919200

Within £5M buget (80800)

80800 ÷ 12 = 6733 can have (A)

Japanese Lesson Study Model



Observe and describe:

- Teaching:
  - what are the most effective prompts and questions?
- Learning:
  - how do selected students respond mathematically?
  - what do they discuss?
  - how do they reason?
- Mathematics:
  - how does the mathematics flow and develop during the lesson?

The Pre-Lesson Briefing

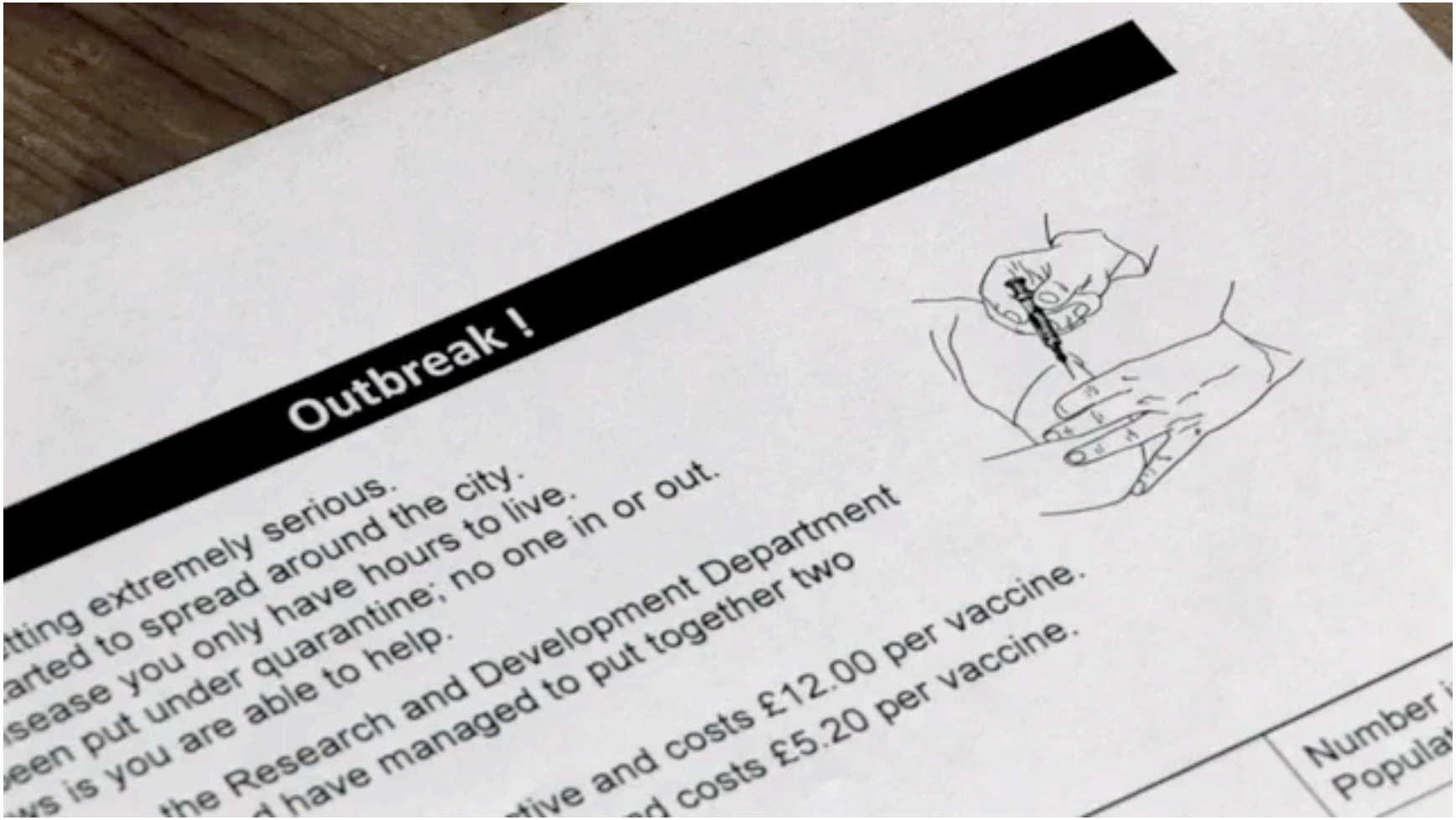
As you observe the lesson make notes:

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?

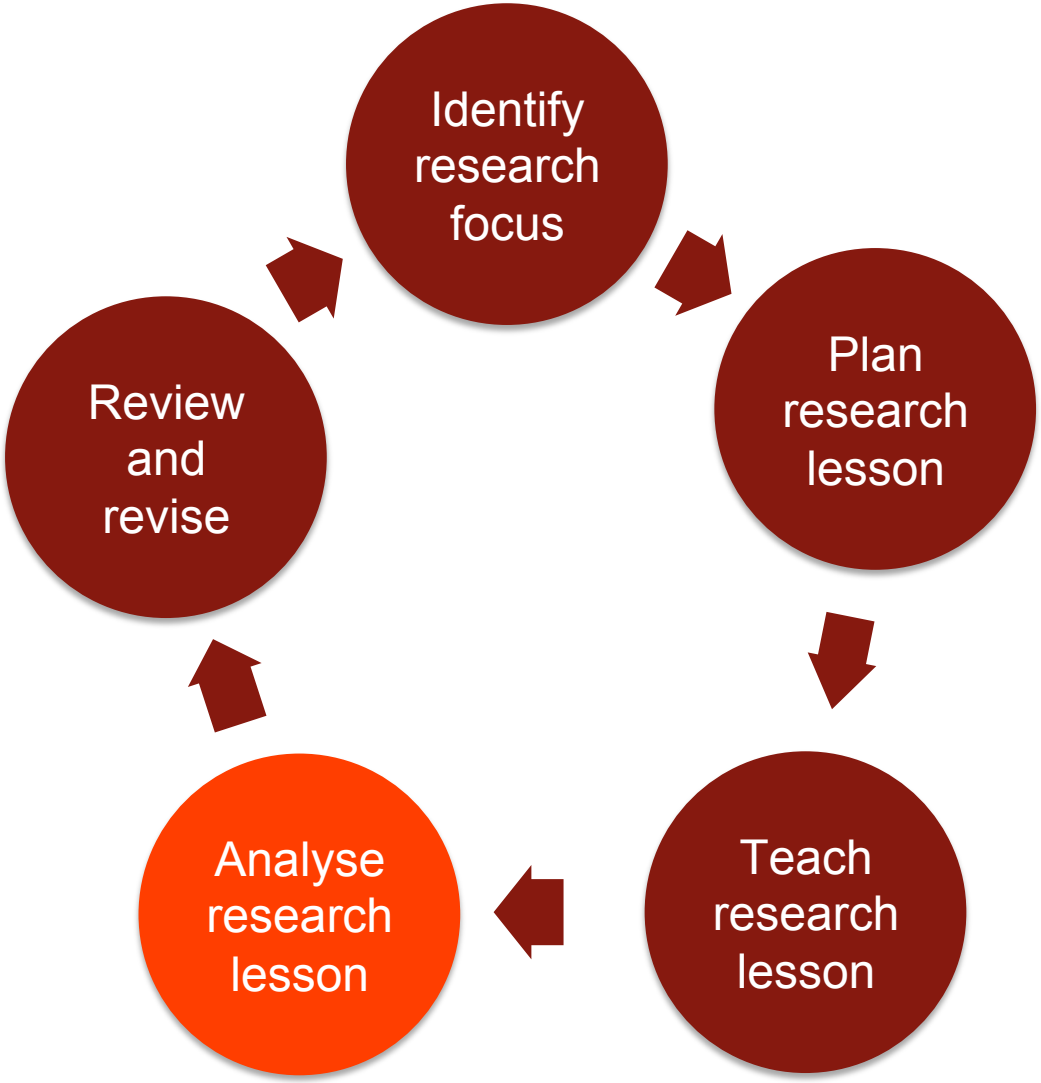
The Lesson


Outbreak !
tting extremely serious.
arted to spread around the city.
sease you only have hours to live.
een put under quarantine; no one in or out.
ws is you are able to help.
the Research and Development Department
have managed to put together two
tive and costs £12.00 per vaccine.
d costs £5.20 per vaccine.
Number
Popula

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

Japanese Lesson Study Model



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.

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?

Planning fostered by interpreting each others' work

Choosing the presentations; Maths, Morals and Monitoring

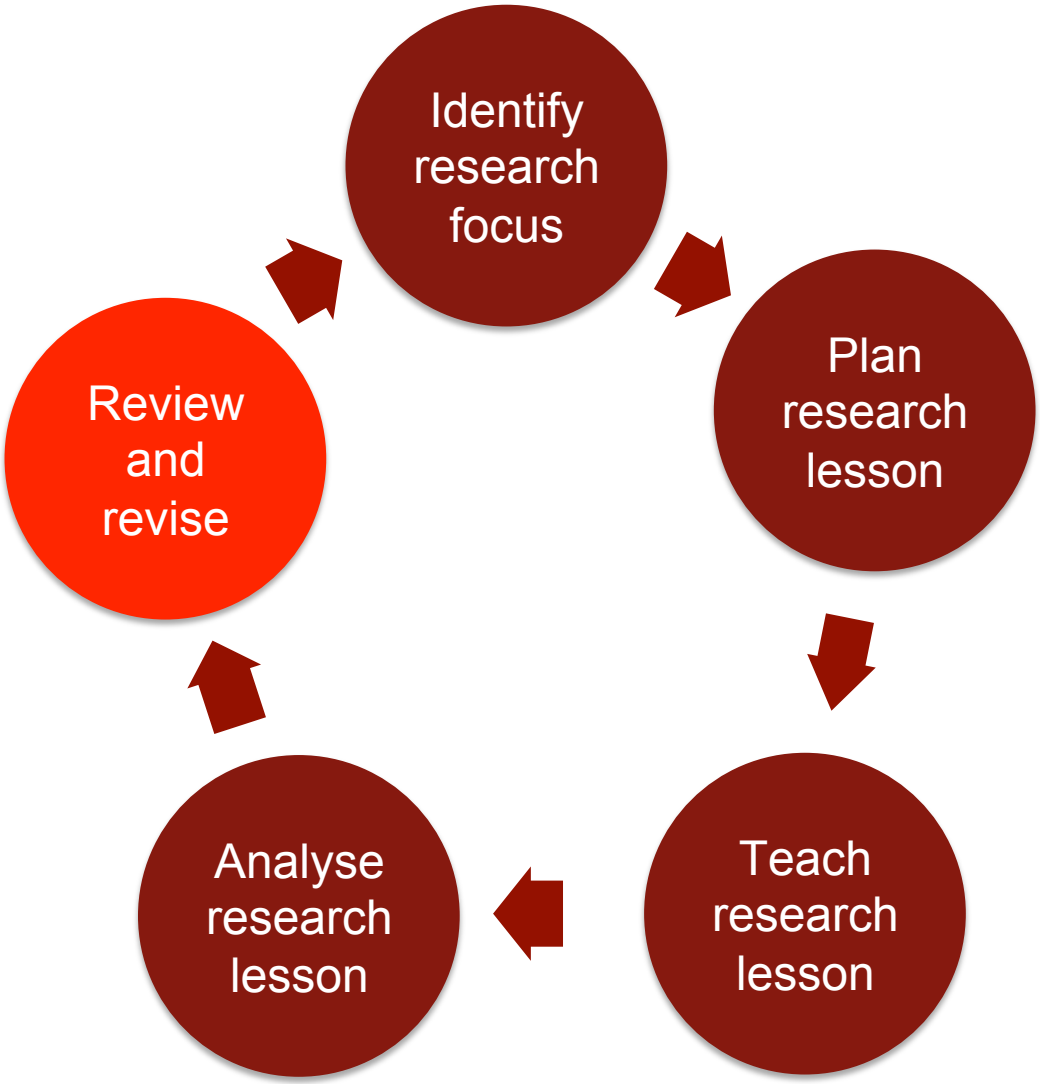
Contribution by the “Koshi”

Issues arising: Planning and monitoring

Planning and monitoring were encouraged by:

- Stopping students and asking them to explain and plan:
  - "Pens down and tell each other what you are doing."
- The teacher's questioning:
  - "How do you know when the money will run out?";
  - "Are we achieving our goal?"
  - "Could you do better than vaccinate everyone with B?"
- The redrafting of solutions:
  - "Put down the steps you were taking."
- Critiquing other students' work
  - These were carefully chosen to focus on two strategies.

Japanese Lesson Study Model



Review and revise

Teachers:

- Review the lesson objectives.
- Review each phase of the lesson, the flow, the timings, the prompts.
- Revise the tasks and questions.
- Revise the anticipated student responses - using actual responses.
- Use student work to illustrate success criteria.
- Reteach the lesson with another class.

What do teachers think about Lesson Study?

Thank you!
<Insert contact details>