Lesson study structured by a discursive resource: benefits and constraints

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Lesson study (in maths education)

- Widespread – across country contexts – different
- In focus at ICME13 – across strands
- Books, special issues ....

Across curriculum

- WALLS annual conference; IJLLS – dedicated journal (not only mathematics)
- Extension into ITE (e.g. Norway)
1. Japan and China - Job embedded, and so part of professional practice – long standing and system wide – influential

- Japan – research lessons, repetition not required, focused question about learning/teaching (USA; UK; Norway; Philippines; Malasia; also through JICA in Africa)

- China – deliberate practice, public lessons, repetition and crafting of skills/practices and lessons, content and strategy focus, variation (Sweden/Hong Kong)
Common elements

• Professional learning Community (teachers, experienced or knowledgeable ‘others’)

• Joint lesson planning, teaching, reflection
Differences/adaptations

• Job embedded
• Teacher driven/externally initiated ‘PD’
• Lesson revision and repetition
• Role of experienced ‘other’,
• (Research) focus
• Theoretical resources.
South African (maths) education context

1. Poverty and educational outcomes - dual economy of schooling

What is made available to learn, for whom, and not just how is critical for an equity/social justice agenda
And so the agenda for the Wits Maths Connect Project

2. ‘Failure’ of educational ‘aid’ interventions

• From ‘traditional’ (ritualised) pedagogy to learner centered (inquiry based) practices in developing country contexts; paradigm ‘clashes’ (Tabulawa, R. – Botswana – “tissue rejection”)
Improving the teaching and learning of mathematics in secondary schools in one province in SA, through linked research and professional development of mathematics teachers.
Mathematical discourse in instruction (MDI):
A socio-cultural framework for describing and studying/working on mathematics teaching

Object of learning

Exemplification
- Examples
- Tasks

Explanatory Talk
- Naming
- Legitimations

Learner Participation

Mediation towards scientific concepts
Mathematics as network of connected concepts
Building generality and appreciating structure
WMCS Mathematics Teaching Framework
Structuring resource guiding planning and reflection

Mediated in the MfT course, and then used in follow on LS

<table>
<thead>
<tr>
<th>Lesson goal</th>
<th>Exemplification</th>
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<tbody>
<tr>
<td>Examples, tasks and representations</td>
<td>Doing maths and talking maths</td>
<td>Word use and justifications</td>
<td></td>
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LS Research Questions

1. What changes in instructional quality (MDI; CHAT)

2. What opportunities for learning for mathematics teachers and researchers
   - with respect to mathematics (concepts, practices)
   - teaching mathematics and (examples, tasks and representations, learner thinking, language issues)
   - doing lesson study (facilitation, social relations, community ‘rules/norms’)

Critical incidents identified by focal points of reflective discussion, provoked by tensions/dilemmas, and seem related to elements of framework

**Chinese framework:** important knowledge point, difficult point and critical point)
Cluster 1, Cycle 1, May 2016

- 4 teachers, 3 WMCS staff.
- Grade 10, 2 schools in Johannesburg.
- Topic: “simplifying algebraic expressions with brackets in different positions”
- 3 meetings (video records):
  - Planning for teaching – joint plan 1
  - Teaching 1 and reflection - joint plan 2
  - (Re-)Teaching 2 and final reflection
- Transcription, identification of Critical Incidents, construction of data and analysis ....
Joint plan

Lesson goal: Learners can simplify expressions with brackets when these are in different positions.

<table>
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<td><strong>Examples, tasks and representations</strong></td>
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<tr>
<td>Pre-test assessment</td>
<td>Write the assessment. Introduction:</td>
<td>Pre-test assessment</td>
</tr>
<tr>
<td>Introduction Introducing the lesson: Calculate the following:</td>
<td>• Learners will work on question a, b &amp; c on own.</td>
<td><strong>Introduction:</strong> The teachers will ask the learners to work individually. Calculate the following here, the teacher will ask the learners not just to work on this using the addition only (or BEMDAS) but also the distributive law.</td>
</tr>
<tr>
<td>a) (4 + 3(4 + 5) =)</td>
<td>• Class discussion re question a, b &amp; c; and BOMDAS and Distributive law.</td>
<td>That introductory activity will be left on the board and introduce Activity 1 with similar numbers and structure so that to compare the two activities.</td>
</tr>
<tr>
<td>b) ((4 + 3)4 + 5 =)</td>
<td>• Comparing</td>
<td><strong>Activity 1:</strong> (Individually or in pairs?) Simplify the following</td>
</tr>
<tr>
<td>c) ((4 + 3)(4 + 5) =)</td>
<td><strong>Activity 1 &amp; 2:</strong> same as introduction</td>
<td>Whole class discussion should happen after the learners try to solve the activity. The main focus is that we see the same numbers, same order and what changing is the brackets.</td>
</tr>
<tr>
<td><strong>Activity 1:</strong> Simplify the following</td>
<td><strong>Activity 3:</strong> Teacher-led discussion: what changes/stays the same if I put brackets “here” ..</td>
<td><strong>Activity 3:</strong> Simplify</td>
</tr>
<tr>
<td>(x + 3(x + 5) =)</td>
<td></td>
<td>Here the teachers will put brackets in different positions in (x - 3x + 5) and then ask the learners about the answer as follows.</td>
</tr>
<tr>
<td>The board might look like this</td>
<td><strong>Activity 4:</strong> Work on own.</td>
<td><strong>Activity 4:</strong> Simplify</td>
</tr>
<tr>
<td>((x + 3)x + 5 =)</td>
<td></td>
<td>Here the teacher should watch the time and decide how to take the four sub-problems (a-d) and to give more time to Activity 5 (post-test activity)</td>
</tr>
<tr>
<td>((4 + 3)4 + 5 =)</td>
<td></td>
<td><strong>Activity 5 (Post-Test): Simplify</strong></td>
</tr>
<tr>
<td><strong>Activity 2:</strong> Simplify</td>
<td></td>
<td>Teacher will watch the time! [Note: this is the same as the pre-test, for assessment purpose.]</td>
</tr>
<tr>
<td>((x + 3)(x + 5) =)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>((x + 3) + (x + 5) =)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Activity 3:</strong> Simplify</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) ((x - 3x) + 5 =)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) ((x - 3)x + 5 =)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) (x(-3x + 5) =)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d) (x - (3x + 5) =)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Activity 4:</strong> Simplify</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) (x - 8(x + 6) =)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) ((x - 8)x + 6 =)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) ((x - 3)(x + 3) =)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d) ((x - 3) - (x + 3) =)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Activity 5 (Post-Test): Simplify</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) (2p - (4 + p) =)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) (2p (-4 + p) =)</td>
<td></td>
<td></td>
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Reflection Lesson 1

• Focal point for T1: “Sticking to the plan” in the face of learner error, albeit unsurprising; “too easy”
  
  – Dilemma of teaching in LS with joint plan
  ...

• Replan with more demanding tasks
**Lesson goal:** Learners can simplify expressions with brackets when these are in different positions.

<table>
<thead>
<tr>
<th>Lesson 1</th>
<th>Lesson 2</th>
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<tbody>
<tr>
<td><strong>Activity 3: Simplify</strong></td>
<td><strong>Activity 3: insert bracket(s) in the expressions on the left side so that the two sides are equal</strong></td>
</tr>
<tr>
<td>1. $(x-3x)+5=$</td>
<td>1. $x - 3x + 5 = -3x^2 + 5x$</td>
</tr>
<tr>
<td>2. $(x-3)x+5=$</td>
<td>2. $x - 3x + 5 = -2x - 5$</td>
</tr>
<tr>
<td>3. $x(-3x+5)=$</td>
<td>3. $x - 3x + 5 = -x^2 - 3x + 5$</td>
</tr>
<tr>
<td>4. $x-(3x+5)=$</td>
<td></td>
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</tbody>
</table>
Critical Incident Activity 3: Unplanned example

• Followed the joint plan and discussed errors

• When he introduced activity 3 as planned, learners started to complain, and so he offered an unplanned example, to exemplify what to do.
Then it’s a good exercise, okay Let’s look at this one, I just made that one for an example because some people are saying that this, it might be challenging. Now I’ve got this expression and I need to insert brackets along this expression (pointing to LHS) such that if I simplify the expression I will get this (RHS) as my final result.

Now I look at it, so if I put a bracket here so I’ve got negative three out there, simplify this and tell me what do you get?

So can you see when I simplify this I get that...
Reflection Lesson 2 ...

T2 raised Activity 3 for discussion as he did not expect learners to have difficulty with the task, and insertion of unplanned example. R1 asked about his solution

T2: ... what I’m thinking is that they just want to, it’s just to see that this is no longer minus three, it’s negative three, this number is an integer so they usually get to working with numbers that if this is negative three and three x plus two x and negative three like that [see the figure] it may have been not easy for them to see that this is an integer.
R1: If it had been plus three there (pointing to -3) what would you have done?

T2: It will still .. mean .. I’m going to multiply, it’s like if it was ... oh, okay, no!

Following discussion on whether this should have been dealt with during the lesson, T2 confidently said:

You know the problem? If you stand up and you disagree with me like face to face then that’s when they will see there’s a problem and now you’ve created an impression to them. But you don’t make it as if you’ve seen, you make it as if you can’t see, you’re asking.
1. Critical incidents – learning opportunities
   • Mathematics, mathematics teaching, doing LS

2. Critical incidents – make visible
   • Role/skills of the ‘experienced/knowledgeable other’
     – Offering suggestions for changing task
     – Facilitating discussion of teachers’ mathematics ‘error’
   • Complex social relations when “mathematics goes wrong” and need for agreed ‘rules’ and ‘roles’

Jaworski 2001, *co-learning partnership*
Pedagogical power
Mathematics power
Educative power

Huang & Shimizu, 2016
Teacher learning and improving teaching through LS
Development of knowledgeable others

Lewis, 2016
Teachers as learners
Facilitators as learners
Doing and researching LS

• Benefits and constraints

For learning
– The value of selection and sequencing
– The value of careful attention to word use
– The workings of changing task demands
– The ‘place’ of LS when ‘weak’ or institutionalised subject knowledge also at issue

For research
– Evidencing teacher learning, researcher learning
– Ethics of selective reporting