WSA-EC Forum 2016

Strategies and Pitfalls in Promoting Mathematical Discourse in Classrooms: Lessons from Research

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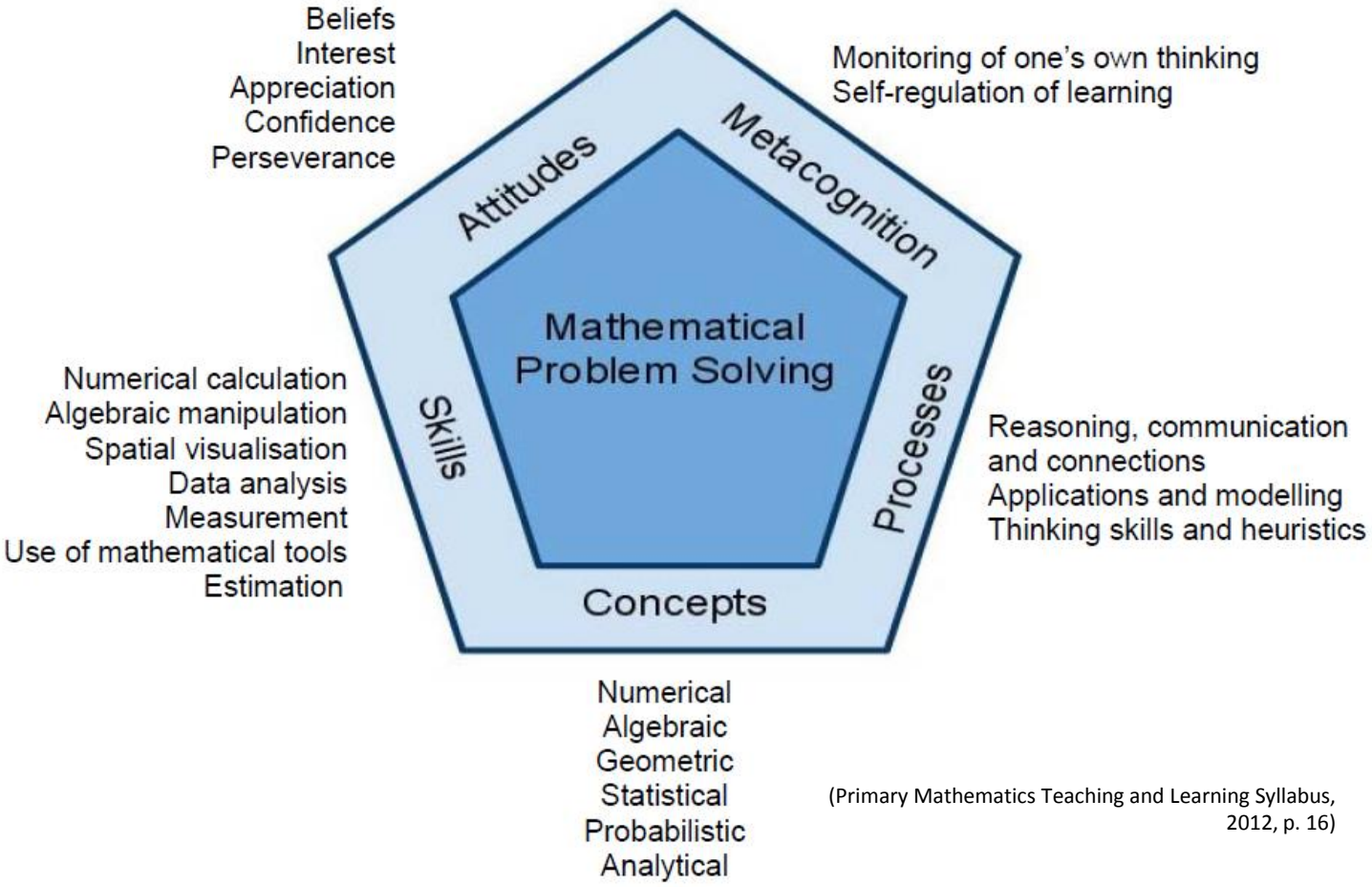
Learning Maths through Mathematical Discourse

- Why?
  - Active engagement with math ideas → mathematical competencies and identities
  - Quality mathematical experience
- What?
  - Learn to communicate about and through mathematics
  - Learners talk to each other
  - Mathematical discussions (whole class, student-student, teacher-student(s))
  - Centred around Big Ideas
  - Explanation
  - Prediction
  - Clarifying
  - Justifying
  - Validating
- How?
  - Learner centric

Mathematics Curriculum Framework



(Primary Mathematics Teaching and Learning Syllabus, 2012, p. 16)

Strategies

- Participation and Obligations
- Students' Articulation of Ideas
- Language in Mathematics
- Mathematical Argumentation

1. Participation and Obligations – Are students talking?

- Outcome
  - All students are engaged in dialogue by encouraging participation and clarifying obligations
- Why?
  - Changes students' perception and learning of mathematics
  - Students create knowledge of what engagement with mathematics is like
- Research:
  - How a teacher sets up classroom expectations and student obligations impacts the quality of discourse and cognitive demand of the engagement

1. Participation and Obligations – Are students talking?

Teachers' Role	Examples	Possible Pitfalls
Clarify, Establish and Enforce Participation Rules • when and how to contribute to mathematical discussions • what to do as a listener Honour all students' contributions Promote respectful exchange of ideas	When your friend is explaining, all of us will listen, think about what is said and respond Before you write down the answer try to convince your friend first. For each statement you make, you must be able to say why it is so Think about how you will ask your friend to clarify his statement (what do you mean?) , justify his statement (how do you know … that x = 2?)	Students do not know how to explain their ideas Highly articulate students dominate Low progress students are passive Inconsistent treatment by teachers

2. Students' Articulation of Ideas: What is the talk about?

- Outcome: Clear articulation of students' ideas by purposeful differentiation between students' ideas and scaffolding students' thinking
- Why?
  - Make their reasoning visible and open for reflection
  - Provide a resource for teacher on what students know/need to know
  - Provide a resource for students to challenge, stimulate, and extend own thinking
- Research: without appropriate pedagogical support, student dialogue will not lead to advancement of students' mathematical ideas

Students' Articulation of Ideas

Teachers' Role	Examples	Possible Pitfalls
Give each student opportunity to: 1) work through problem under discussion, 2) listen to and attend to others' solutions 3) Build on each others' thinking Notice and Listen carefully to what students say Provide responsive rather than directive support Question for understanding Ensure goal of task is achieved Tie together different approaches to a solution (for all students)	Would anyone else like to add anything… to S1's explanation? Would anyone like to have a go at answering S2's question? Does this formula work all the time? Do you think these 2 patterns are related? Is there another way to represent this? S3 said this, do you agree? Why?	Accepting all answers without differentiating their mathematical integrity Lack synthesizing various student contributions Student sharing as an end in itself, does not move thinking forward Too much scaffolding that prevents any productive struggle

Language in Mathematics:
Are students' intuitive understandings transformed into mathematical understandings through mathematical language?

- Outcome: Students acquire appropriate mathematical understandings through mathematical language
- Why?
  - Language is a bridge between everyday ideas and the disciplinary ideas
  - Language constructs meanings for students
- Research
  - Quality of teacher-student interactions directly related to students' sense-making of mathematical ideas
  - Key indicator of understanding is students' increasing use of mathematical language in their articulations
  - Students' mathematical understanding may be hampered by

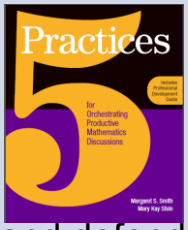
Language in Mathematics

Teachers' Role	Examples	Possible Pitfalls
Move from teachers' use of mathematical language to students' use Sensitize students to particular meanings of words	What does the equal sign mean? estimate? table? less than and more; how many more?	Students may have great difficulty understanding "simple" math language, Everyday understanding of a word may be different from the mathematical understanding Low progress students may not be able to 'crack the code' because of poor command of language Syntax of word problems may not be readily understood leading to keyword interpretations

Mathematical Argumentation – Are students constructing knowledge through mathematical communication, reasoning and making connections?

- Outcome: Students use mathematical language and process skills to develop mathematical understandings
- Why?
  - Develops student identity as learners and doers of mathematics
- Research
  - Development of student mathematical thinking depends not so much on exchange structures, rather the extent to which students are regarded as constructors of mathematical knowledge
  - discussion, debate, and critique are all learned strategies for students
  - One aspect of quality mathematics pedagogical practice is teacher's press for understanding

Mathematical Argumentation

Teachers' Role	Examples	Possible Pitfalls
Skilful orchestration of classroom discussion Model good argumentation Make conceptual connections Provide time for exploring ideas/connections Encourage student self-monitoring Sustained press for explanation, meaning, and understanding	Anticipating Monitoring Selecting Sequencing Connecting  Students' take and defend position against claims by other students (e.g., 7 is an even number) Elicit , support, extend	Expecting students to engage in mathematical argumentation without explicit modelling and teaching

Summary

- Participation and Obligations
- Students' Articulation of Ideas
- Language in Mathematics
- Mathematical Argumentation

Previous Work on Mathematical Discourse

- Paper by Walshaw and Anthony

- The teacher's role in classroom discourse:
  A review of recent research into mathematics classrooms

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