Dialogue and shared cognition: Student-student talk during collaborative problem solving

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Socially shared cognition

- Vygotsky (1978): Sociocultural theory of learning
- Hutchins (2006): Distributed cognition
- Dunbar (1998): Social brain hypothesis
- Resnick, Levine, and Teasley (1991): Shared cognition
- Mercer (2000) and Littleton and Mercer (2013): Interthinking

We employ the term *socio-cognitive* (Van Dijk, 2008) to both acknowledge the fundamentally social nature of human cognition (Mercer, 2016) and also to contest the image of a cognitively bounded individual.

The Social Unit of Learning Project

- Collaborative problem solving and learning are priorities in contemporary education internationally, but these complex processes have proved difficult to research
- This project uses collaborative problem solving in mathematics to investigate the social nature of learning utilising the new laboratory classroom located in the Melbourne Graduate School of Education

Alternative theoretical frameworks

- Negotiative foci of student interaction
  Dr Esther Chan & Prof David Clarke, *The University of Melbourne, Australia*
- Mathematical sophistications in collaborative problem solving
  Dr Dung Tran, *Victoria University, Australia*
- Dialogic talk between students
  Dr Javier Díez-Palomar, *University of Barcelona, Spain*
- Student motivating desires
  Dr Laura Tuohilampi, *University of Helsinki, Finland*
- Students' repertoires of participation
  Dr Josephine Moate, *University of Jyväskylä, Finland*
- Student agency and power
  Juuso Nieminen , *University of Helsinki, Finland*
- Mathematical competencies
  Andreas Pettersen, *University of Oslo, Norway*
- Student interactivity
  Prof Anna Sfard, *University of Haifa, Israel*
- Mathematical representation
  Dr Sebestian Kuntze and Marita Friesen, *Ludwigsburg University of Education, Germany*
- Synchrony in physiological response
  Prof Ross Cunnington and team, *University of Queensland, Australia*

Aim of this paper

- To better understand the socio-cognitive aspect of collaborative problem solving.
- We refer to the notion of *co-cognition* (as employed by Heal, 1998) and propose the terms *inter-cognition* and *intra-cognition* as different kinds of socio-cognitive activity.
- These terms are operationalised using data from the Social Unit of Learning project, which involved student collaborative problem solving activity in a laboratory classroom.

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Professor David Clarke *The University of Melbourne*
Project manager
Dr Esther Chan *The University of Melbourne*
International collaborator
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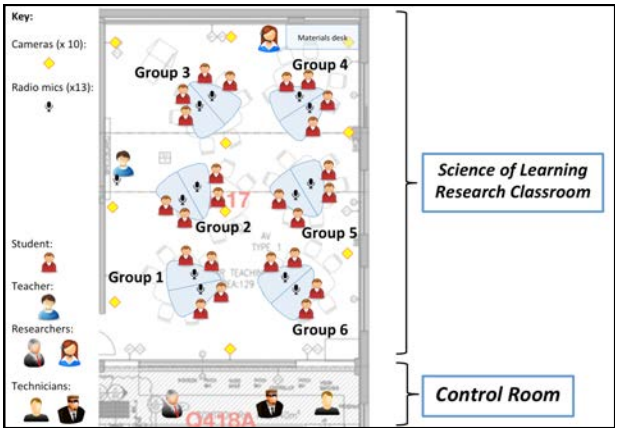
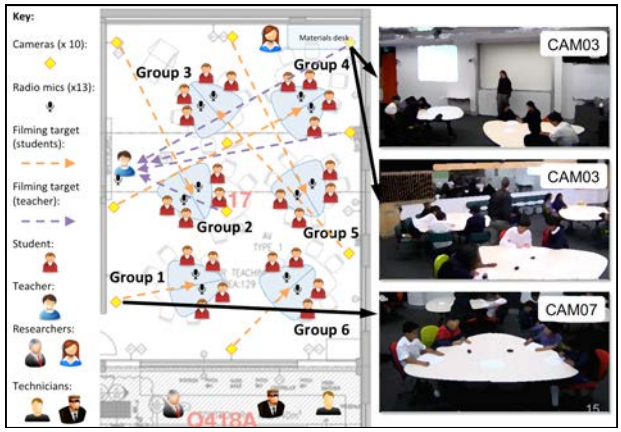
The Science of Learning Research Classroom

The University of Melbourne, Australia

Participants

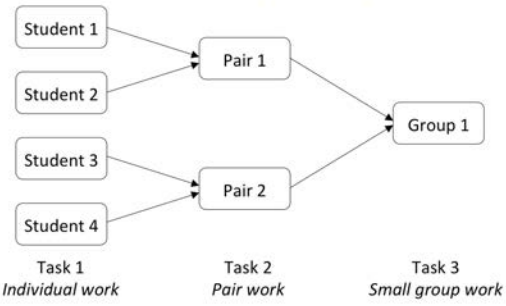
- A secondary school in metropolitan Melbourne
- 2015-2016: Twelve intact classes of Year 7 students (12 to 13 year olds) with their usual maths teachers (~300 students)
- 24 to 26 students in a class





Activity Structure

(2015 March & April Sessions)



Instructional Stimuli

The mathematical tasks employed had the characteristics of being:

- open-ended (amenable to multiple solution methods and having multiple correct answers)
- either explicitly or implicitly including both symbolic and graphical elements
- either explicitly or implicitly affording the possibility of connection to contexts outside the classroom.

The tasks are taken from the research of Clarke and Sullivan: for example, Clarke (1996), Clarke and Sullivan (1990, 1992), and Sullivan and Clarke (1988, 1991, 1992).

Task Two

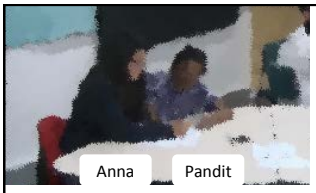
The average age of five people living in a house is 25. One of the five people is a Year 7 student.

What are the ages of the other four people and how are the five people in the house related?

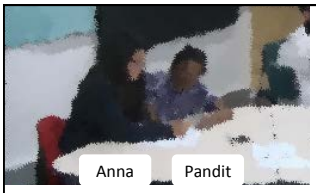
Write a paragraph explaining your answer.

Operationalising socio-cognitive activity

- Co-cognition (Heal, 1998): a person's capacity to mentally simulate the thoughts of another



Anna: Twenty-five.
Pandit: Why are you saying that dude's 25? They don't have to be 25.
Anna: It - it - this one is 25 because that's the average.
Pandit: Average doesn't have to - doesn't mean that one guy has to be 25.
Anna: Oh okay, okay. That makes sense then.
Pandit: Altogether it's 125 because like ...
Anna: Yeah, yeah, yeah.
...



Pandit: Yeah, yeah. So one dude's 13. That means the other four is 112.
Anna: What do you mean? No. It can't - they can't all be like so equal.
Pandit: They're not. Oh my God. Look, so 25's one guy, right. No. It's like for, you know, average means like ...
Anna: I know, I know.
Pandit: Yeah. So 25 times five is the total, right?
Anna: Yeah. I know.
Pandit: So everyone's 125. And one guy is 13.
Anna: I know, one guy. So ...

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Operationalising socio-cognitive activity

- Co-cognition (Heal, 1998): a person's capacity to mentally simulate the thoughts of another
- Inter-cognition: extending or building upon the thoughts of another

Katie: Let's write the explanation now. Why did we choose these ages?

Audrey: We chose these ages as we wanted a variety (laughs).

Katie: We wanted …

Audrey: Because they were all just - ah, I just stabbed myself with a pen. No. Does this have to be …

Katie and Audrey: (Laughter)

Katie: Forty-five, forty-five doesn't make a variety.

Audrey: Just say because we wanted a variety of ages.

…

Audrey: … We know this is correct as … as we have used addition to add them all.

Katie: We …

Audrey: We used addition to …

Katie: No. We can't say it's correct because there could be many answers.

Audrey: Oh we know this is one of the many answers.

Katie: We know… (Laughs).

Katie: … the answers. As…

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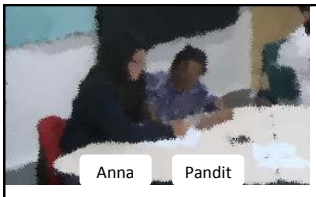

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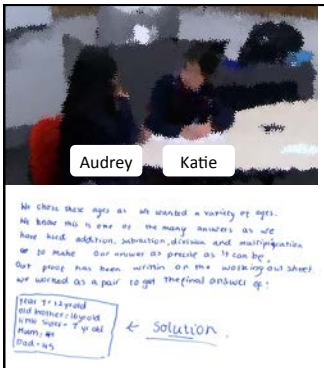

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Discussion

- We postulate that these different kinds of socio-cognitive activity are crucial for effective collaborative work as students each think about the other person's thinking (co-cognitive); build on each other's thinking (inter-cognitive); and regulate each other's thinking as a single cognising unit (intra-cognitive).

Discussion (cont'd)

- The nomenclature (co-cognitive, inter-cognitive, and intra-cognitive activity) distinguished in this paper represents the objectification by the participants of their own thought processes (separately and in combination) as suitable matter for evaluative reflection and control by the participants.

Further work

- Our future research will involve examining the connection between the presence and absence of these different forms of socio-cognitive activity in different student groups and the quality of the student collaboration.
- What is the extent to which middle school children can be led to describe their understanding of their classmates' thought processes?

Final thoughts

- We argue that effective collaborative problem solving requires anticipating differences in each other's thought processes.
- Teachers and students could benefit from re-orienting their attention to individual's capacity to model each other's thought processes during student collaborative problem solving and classroom learning in general.

For more details

Clarke, D. J., & Chan, M. C. E. (2020). Dialogue and shared cognition: An examination of student-student talk in the negotiation of mathematical meaning during collaborative problem solving. In N. Mercer, R. Wegerif & L. Major (Eds.), *International handbook of research on dialogic education* (pp. 581-592). Abingdon, Oxon, United Kingdom: Routledge.

Thank You

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For information about the project, visit:

http://socialunitoflearning.iccr.edu.au

For information about the International Centre for Classroom Research (ICCR), visit:

http://www.iccr.edu.au

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