# WG 9 Language and Mathematics

# Reports of Session 1

## Students' mathematical meanings and practices

| TITLE | AUTHOR |
|---|---|
| Seeing-acting-speaking in geometry: A case study | T. Barrier, C. Hache & A.-C. Mathé |
| Meanings of the concept of finite limit of a function at one point: Background and advances | J. A. Fernández-Plaza, L. Rico & J. Ruiz |
| Linguistic intercourse with spatial perception: Comparative analysis in primary school, infant school and the family | M. Schütte |

# Some facts on language

- Language is contextual.
- Learning mathematics means entering in specific:
  - ways to interpret the world
  - language practices
- Language is at the same time:
  - part of the focus of learning
  - medium of the social negotiation of the specificity of mathematical practices and of the meanings of terms;
    - most of these terms are extracted from everyday language.

# Some examples

- The meaning of the word "circle" (Hache, Mathé), and the meaning of specific terms related to the concept of limit (Fernández-Plaza).

- The explicit or implicit use of language in the learning of spatial geometry
  - deictical language with pointing vs. the teacher acting as a model for learning the language of mathematics (Schütte)

# … and some questions

- What is the role of language in the negotiation of particular meanings in mathematics?

- Which are the difficulties because of conflicts between everyday and mathematical meanings?

- How to support pupils in the learning of the language of mathematics?

  – How to train teachers about this?

  – What are the competences required by the teachers and students concerning the use of the language of mathematics?

# Reports of Session 2

## Semiotic systems and representations

| TITLE | AUTHOR |
|---|---|
| Place of the conversion of semiotic representations in the didactic framework $R^2C^2$ | M. Priolet |
| Making sense of fractions given with different semiotic representations | F. Rønning |
| Perceiving calculus ideas in a dynamic and multi-semiotic environment –the case of the antiderivative | O. Swidan |
| Choice of notation in the process of abstraction | M. Nosrati |

- Topics of the session
  - Mediation by semiotic representations
  - Use of artefacts
  - Working with specific mathematical concepts
- What is being solved?
  - Looking into processes of learning/perception/ meaning making
  - Students' choices in the learning process

- Aim of the research
  - Based on carefully designed learning environments
  - Implications for pedagogical practice
- New directions
  - Design similar learning environments centered around other mathematical concepts
  - Students' choices have been described: What is behind theses choices?

# Reports of Session 3

## Group discussion, norms and communication

| TITLE | AUTHOR |
|---|---|
| Design and validation of a tool for the analysis of whole group discussions in the math classroom | L. Morera, N. Planas & J. Fortuny |
| Factors affecting the establishment of social and socio-mathematical norms | K. Tatsis |
| The productive role of interaction: Students' algebraic thinking in whole group discussion | N. Planas & J. Chico |
| Writer identity as an analytical tool to explore students' mathematical writing | S. Iversen |

# Why this grouping?

What the four papers have in common is that each points somehow to the question raised by Candia in her plenary:

*How does the use of language position students in relation to (the learning of) mathematics?*

| KEY NOTIONS | INTERPRETATIONS |
|---|---|
| Language use | Verbal acts (and interaction) |
| Discourse | Language in action |
| Mathematics | School mathematical practices |
| Learner | Student in a classroom |
| Learning | (Opportunities for) Participation |
| Identity | Positioning in a school mathematics discourse |

# Reports of Session 4

## Diverse languages in the teaching and learning of mathematics

| TITLE | AUTHOR |
|-------|--------|
| A comparison of Irish and English language features and the potential impact on mathematical processing | M. Ni Ríordáin |
| An investigation into the tension arising between natural language and mathematical language experienced by mechanical engineering students | M. D. Peters & E. Graham |

# Why this grouping?

What the two papers have in common is that each points to experiences of language tensions in the learning of mathematics.

| LANGUAGE TENSIONS | AUTHOR |
|---|---|
| School dominant language (English / Irish-Gaeilge) vs. Home dominant language (Irish-Gaeilge / English) in the bilingual mathematics classroom at primary | M. Ni Ríordáin |
| Formal language (mathematical register) vs. Informal language (natural register) in mechanical engineering students' expression of their mathematical thinking | M. D. Peters & E. Graham |

# Significant differences

There are important differences between the two papers' empirical and theoretical approaches.

| CRITERION | DIFFERENCE |
|---|---|
| Theories | (Psycho-)Linguistics, Embodied Cognition |
| School levels | Primary, College |
| Objects | The Irish-Gaeilge language, The mathematics register |
| Methods | Semantic and syntactic analyses, Content analysis |
| Data sources | Semantics and syntax, Students' task-based questionnaires |
| Emphases | Language production, Speech and communication |
| Assumptions | Language processing mediates mathematical thinking, Environmental conditions mediate mathematical thinking |

# Reports of Session 5

## Use of tools and interactional strategies by teachers

| TITLE | AUTHOR |
|---|---|
| The use of ICT to support children's reflective language | E. Riesbeck |
| Primapodcasts: Vocal representation in mathematics | C. Schreiber |
| The influence of how teachers interactionally manage mathematical mistakes on the mathematics that students experience | J. Ingram, F. Baldry & A. Pitt |

# Main facts

- The emphasis was on ICT as a tool for communication.
- Children do engage in communicating about what they have learned with technology.
- Podcasts – videocasts
  - cannot change
    - students need drafts
  - are essentially different from other outputs
  - the audience is different

# … more facts

- ICT do not necessarily improve communication

- Computers enable to rewind and revisit

# Key point

- Different tools
  - camera
  - on the computer
  - podcasts

- Different communication
  - forms/structure
  - language
    - more mathematical
    - more reflective

# Questions and suggestions

- Can ICT tools change the norms of interaction?

- What is the influence of
  - the tool itself?
  - the (number of) person(s) who interact?
  - the way of interaction?

# Reports of Session 6

## Didactical environments, scaffolding and mediation

| TITLE | AUTHOR |
|---|---|
| A linguistic analysis of the didactical environment in support of the scaffolding concept | T. Dias & C. T. Christinat |
| Reading stories to work on problem solving skills | M. Moulin & V. Deloustal-Jorrand |

- # Similarities:
  - Work on **oral** language used between teacher and pupils.
  - Presence of a paradoxical question concerning the didactical contract. The problem is avoided by the pupils.
  - The teacher gives the task not to be solved but to help the pupils to learn from the task.

- # Findings:
  - Scaffolding by making the problem more like real life makes the situation worse, the pupils give more paradoxical answers.
  - Using a story in the classroom instead of a usual text problem can lead to dividing the problem into small parts – reducing the complexity and the antagonism expected by the didactical situation.
  - Because of the references included in the language, children tend to consider each problem as a case of a general set of problems.

- Two approaches :
  - Start with a didactical question and look at it from a linguistic perspective
  - Start with a linguistic question which leads to didactical approach
- Questions, new directions for research:
  - The language can help learning new knowledge. However, could it also be a factor preventing pupils from learning ?