DIGITALLY-MEDIATED MATHEMATICAL MEANINGS

the contribution of

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Maria Alessandra and CERME and us ☺

ERME started unofficially with a conference called ERCME (CERME 0) in Podebrady (Czech Republic) in 1997.

we ‘think’ we three were all there.....

Mariotti M.A (1997) Justifying and proving: figural and conceptual aspects, in Hejny M. & Novotna J. (eds) Proceedings of the European Research Conference on Mathematical Education)

The purpose of the study is to clarify the role of a particular software,Cabri-géomètre, in the teaching/learning process. Assuming a Vygotskian perspective, attention is focussed on the **social construction of knowledge** and on the role of tools

Healy and Hoyles (1997)
Student's Performance in proving: competence or curriculum

CERME Podebrady (Czech Republic) in 1997.

CERME 1 in Osnabrück, Germany (1998)
Chair: Elmar Cohors-Fresenborg
CERME 2 in Marianske Lazne, Czech Republic (2001) Chair: Jarmila Novotna

CERME 3 in Bellaria, Italy (2003)
Local Chair: Maria Alessandra Mariotti
Program Chair: João Pedro da Ponte

Meanwhile we all met again and presented papers at PMEs in particular PME 13 in Paris (1989).

Proceedings at

https://www.igpme.org/publications/current

Fast forward to 2009 after many interactions ☺

17th ICMI Study: Digital Technologies and Mathematics Teaching and Learning: Rethinking the Terrain

Hoyles, C & Lagrange, J-B 2009

highlighted diversity

- available software, hardware & resources, access to Web ,,,
- curricula organisations from highly centralised to locally autonomous
- modes of teaching

addressed issues

- teacher beliefs & practice
- importance of design
- gender & disadvantage

how can technology be used to benefit the less advantaged rather than serve as yet another source of disadvantage?

ICMI Study Conference Technology Revisited Hanoi university of Technology (HUT). DEC 2006

Our approach to construction is/was through programming……..

Seymour Papert with

Richard and Celia in Hanoi prior to Seymour’s keynote

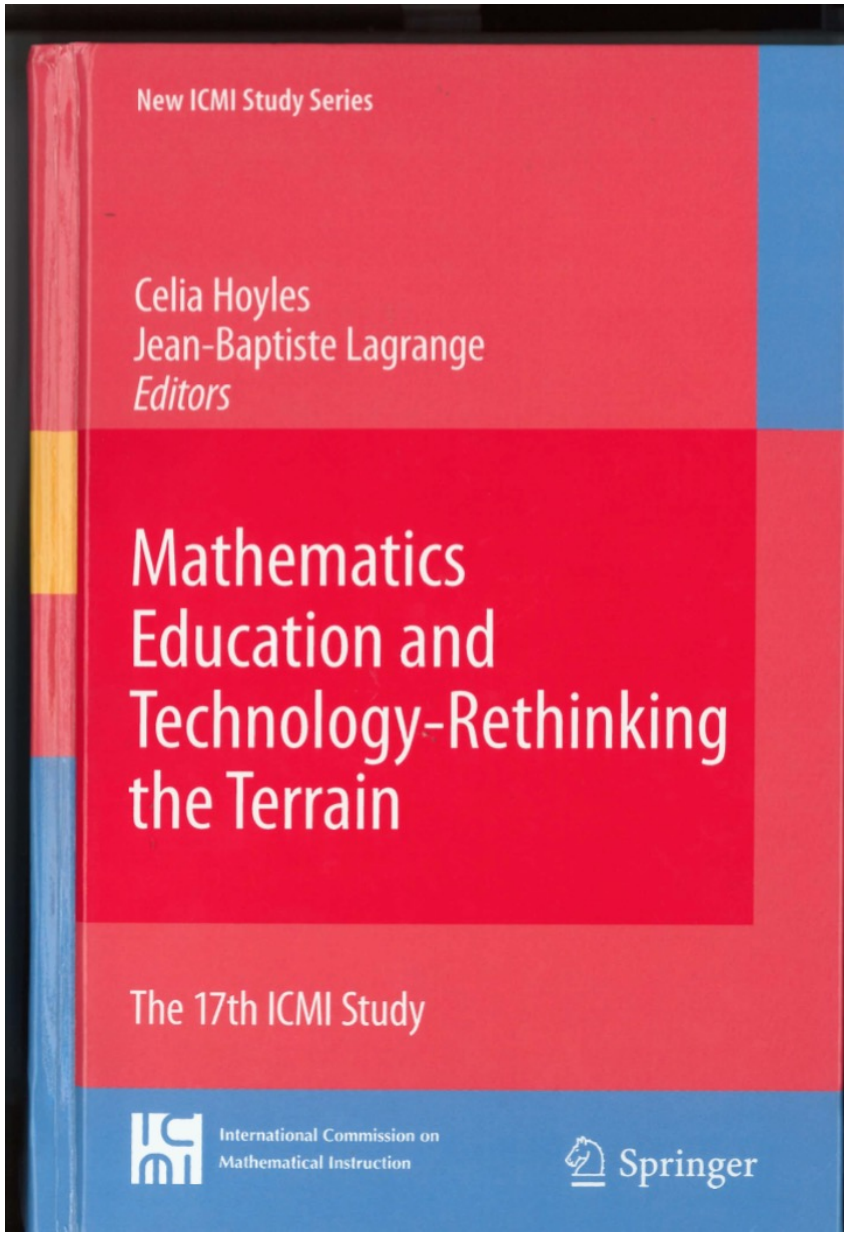
The International Programme Committee for ICMI 17

Hard at work in UCL Knowledge Lab Jan 2007 ☺

Hoyles. C and Lagrange J-B (eds) (2010)
Mathematics Education and Technology-Rethinking the terrain Springer

The book that followed……

Maria was a Section Lead



Integrating Technology into Mathematics Education
Theoretical Perspectives

What theoretical frames are used in technology-related research in the domain of mathematics education and what do these theoretical perspectives offer?

current developments: instrumental approaches and semiotic mediation.

Paul Drijvers, Carolyn Kieran, **Maria-Alessandra Mariotti,**
Janet Ainley, Mette Andresen,
Yip Cheung Chan, Thierry Dana-Picard, Ghislaine Gueudet, Ivy Kidron, Allen Leung,
Michael Meagher

While discussing future trends, the authors observe theoretical advancements; still, the articulation of different theoretical frameworks is not realized, some aspects remain underexposed, such as

- role of language in instrumental genesis
- role of the teacher in technology-rich learning environments
- influence of the available tools on tasks and task design

And

Connectivity, both among technologies and among theoretical frameworks, might be **a key focus** for future studies

A plea was made for the development of

- **integrative theoretical frameworks** that allow
- **for the articulation of different theoretical perspectives**.

In summary

Professor Maria Alessandra Mariotti's work, especially in the field of **semiotic mediation**, has significantly contributed to understanding how tools, signs, and artifacts can support mathematical learning.

We have discussed together how Maria's work complements our notion of **situated abstraction**

Noss, R. and Hoyles, C. (1996) *Windows on Mathematical Meanings: Learning Cultures and Computers*. Dordrecht: Kluwer Academic Publishers.

We suggest **frameworks are complementary** highlighting different facets of the learning process.

- Semiotic mediation provides a structured pathway to abstraction
- Situated abstraction emphasizes more the importance of context and learner agency in developing mathematical ideas. Role of teacher?

Major publication

Introducing students to geometric theorems: how the teacher can exploit the semiotic potential of a DGS

ZDM 2013/5
Volume 45 441-452

Since their appearance new technologies have raised many expectations about their potential for innovating teaching and learning practices; in particular any didactical software, such as a Dynamic Geometry System (DGS) or a Computer Algebra System (CAS), has been considered an innovative element suited to enhance mathematical learning and support teachers' classroom practice. This paper shows how the teacher can exploit the potential of a DGS to overcome crucial difficulties in moving from an intuitive to a deductive approach to geometry. A specific intervention will be presented and discussed through examples drawn from a long-term teaching experiment carried out in the 9th and 10th grades of a scientific high school. Focusing on an episode through the lens of a semiotic analysis we will see how the teacher's intervention develops, exploiting the semiotic potential offered by the DGS Cabri.

More recently

Abduction in Generating Conjectures in dynamic Geometry through Maintaining Dragging. Available from: https://www.researchgate.net/publication/252321226_Abduction_in_Generating_Conjectures_in_dynamic_Geometry_through_Maintaining_Dragging [accessed Mar 07 2025].

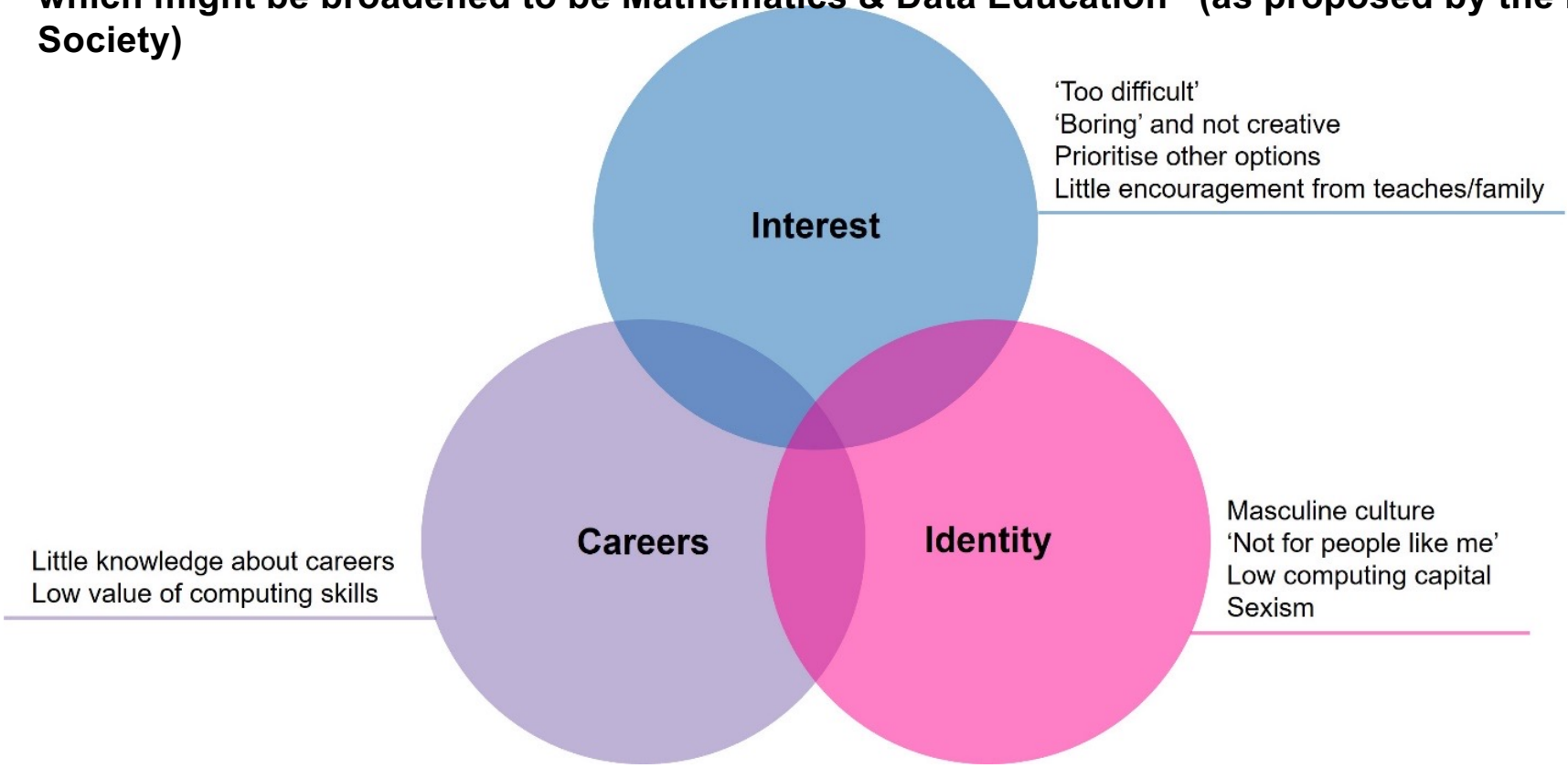
The successive analyses of our data led to the development of a new notion, that of **instrumented abduction**, through which we describe the place and role of abduction in the process of conjecture-generation (Baccaglini-Frank & Mariotti,2010; Baccaglini-Frank, 2010).

BUT significant challenges need to be addressed in mathematics education we contend

- access to digital technology
- effect on participation of girls and more disadvantaged students
- **motivation** to engage with mathematics

Hugely critical especially now….

Barriers for girls to take part in computing education -….and could be the same for Mathematics which might be broadened to be Mathematics & Data Education (as proposed by the Royal Society)



Representation in Computing Education: why are certain groups of students significantly underrepresented in computing qualifications? Draft report Royal Society 2025

Thank you Maria Alessandra for your years of inspiration & friendship

Thank you Anna for organizing this event and inviting us to join you

Similarities

1. **Role of Tools and Artefacts**

Both frameworks recognize tools as central to learning, emphasizing how they support the transition from concrete experiences to abstract thinking.

2. **Social and Cultural Dimensions**

Both approaches view learning as a social activity, where meaning emerges through interaction with tools, peers, and teachers.

3. **Dynamic Process**

Both view learning as linear but as an evolving process involving negotiation and reinterpretation of meaning.

4. **Focus on Meaning-Making**

Both emphasize how learners construct and transform meanings, bridging personal understanding and formal mathematical structures.

Differences

Theoretical Roots

Rooted in **socio-cultural theory** (Vygotsky). Rooted in **constructionist theory** (Papert).

Role of Teacher

Strong focus on teacher intervention to guide the transition from personal to shared meanings.

Teacher acts more as a facilitator, allowing students to explore and construct meaning independently.

Nature of Abstraction

Abstraction involves **generalizing meanings** of tools and signs into formal mathematical ideas.

Abstraction emerges as **context-dependent** shaping and shaped by students' goals and activities.

Focus on Context

Stresses how tools mediate between **individual cognition** and **cultural norms**.

Stresses how meaning is rooted in **specific activities** and **authentic tasks**.

Use of Signs

Focuses on the **evolution of signs** (e.g., diagrams, symbols) from everyday usage to formal mathematics.

Focuses on **action and interaction** with tools, where signs are embedded in situated activity.