From educational research to course design: easing the transition to university mathematics

Paola Iannone

The University of Edinburgh

paola.iannone@ed.ac.uk

THE UNIVERSITY *of* EDINBURGH

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Background

- Understanding the transition from school to university mathematics may be an equality and inclusion issue: Mathematics degrees are ‘very valuable’ in terms of employment

- Many *actors* can contribute to facilitate the transition: teachers, colleagues involved in mathematics support centers, lecturers, secondary teachers ...

- The School of Mathematics at the University of Edinburgh has carried out a pre-honours course review and has decided to create an ‘introduction to proof ’ type course in the first semester of the first year: **Introduction to Mathematics at University.**

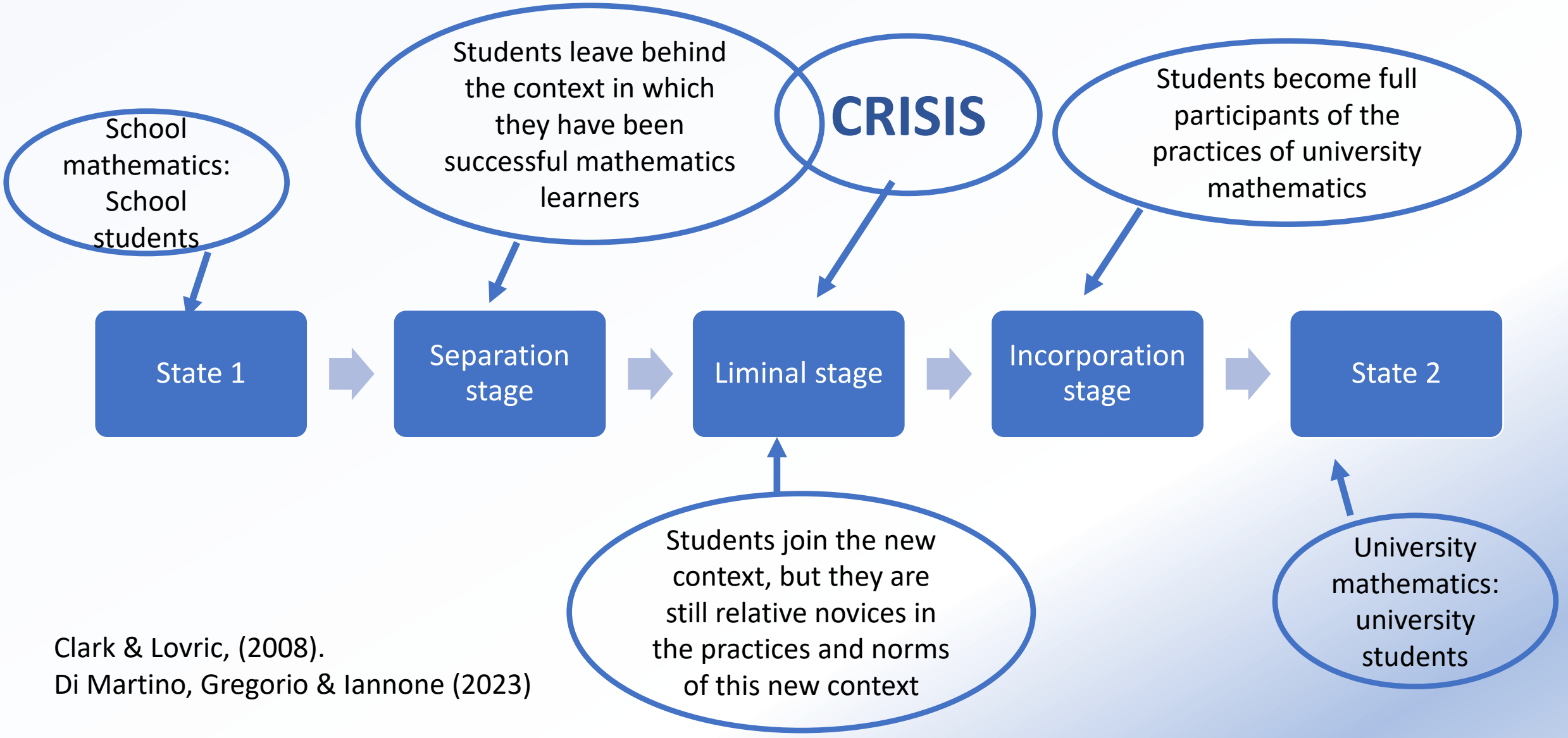
Gueudet et al. (2016) highlight 2 perspectives on the tertiary transition:

- **Cognitive:** difficulties with new mathematical concepts and with mathematics' epistemology;
- **Sociocultural:** changes of the pedagogical culture of mathematics at university with respect to that of mathematics at school. Impact on the shift of social background, Habitus, Capital, Bourdieu. Situated cognition.

Later, Di Martino and Gregorio (2018), and Geisler and Rolka (2020) showed also the role of affect

- **Affect:** psychological-social phenomena such as emotion, love, belief, attitudes, interest, curiosity, fun, engagement, joy, involvement, motivation, self-esteem, identity…

Rite of passage into university mathematics?



Clark & Lovric, (2008).
Di Martino, Gregorio & Iannone (2023)

Cognitive crisis: Students cannot ‘do’ proof!

Epistemological difficulties	Students arriving at university often fail to realize the role that proof has in pure mathematics and why it is necessary
Proof comprehension	How well students understand proofs which are presented to them? Students often do not have a general understanding of the key ideas of a proof but at best check line by line reasoning.
Proof writing	Students and their lecturers do not share the same understanding on what constitutes an ‘academic style’ of proof writing.
Proof appraisal	Students are often unable to ascertain the validity of proofs when they read them, often trusting the ‘authority’ of the person who presented the proof to them
Proof composition	Several students’ difficulties are found regarding proof composition. Among these there is the inability to use the definitions in the context of a proof, the uncertainty on how to start a proof and how to partition a proof into goals and sub-goals.

But is cognition all the difficulty?

Sociocultural: Students are not in small A-level classes and most likely they are not the best anymore ‘Big fish small pond’. More independent study, less guidance.

Affective: vision of self changes: ‘the mathematics is too difficult’ or ‘I am no longer good at mathematics’ stimulate negative affective reactions which impact on learning.

These need to be addressed together with the cognitive difficulties!

What to do: scaffold students during the crisis through course design

- The crisis – which manifest itself in the three aspects mentioned earlier - is necessary: without crisis there is no transition in the new community

- However, the crisis – if not supported, can lead to high drop out (Di Martino and Gregorio, 2019)

- So how can we support the crisis also – but not only – through course design?

Introduction to University Mathematics course

- Predominantly workshop based (2 hours per workshop)
  - Guided from the front by teaching team
  - Scaffolded activities for peer collaboration, 1 tutor per 24 students
- Each block contains 5 workshops:

- Covering areas students typically find difficult in their transition

Assessment: portfolio of proofs and dialogic (oral) assessment.

Thank you to my colleagues at the University of Edinburgh

Dr Wei En Tan

Dr Steven O’Hagan

THANK YOU FOR LISTENING!

Over to my colleagues now