A research agenda for computer-aided assessment of university mathematics

EAMS
21 June 2021

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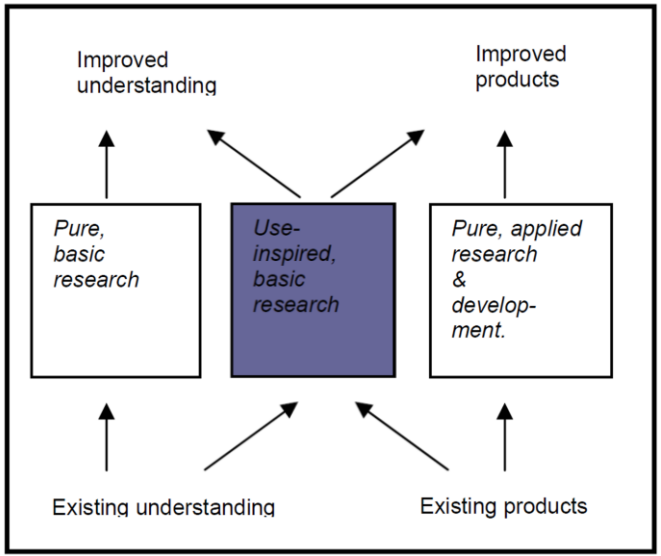
Aims

develop a shared research agenda for computer-aided assessment of university mathematics



Lester, F. K. (2005). On the theoretical, conceptual, and philosophical foundations for research in mathematics education. ZDM - International Journal on Mathematics Education, 37(6), 457–467. https://doi.org/10.1007/BF02655854

Collaborative agenda-setting

- A collaborative process
- Modelled on previous exercises
  (Alcock et al., 2016; Sutherland et al., 2011)

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Theoretical Contributions

Challenges in Mathematical Cognition
A Collaboratively-Derived Research Agenda

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Abstract

This paper reports on a collaborative exercise designed to generate a coherent agenda for research on mathematical cognition. Following an established method, the exercise brought together 16 mathematical cognition researchers from across the fields of mathematics education, psychology and neuroscience. These participants engaged in a process in which they generated an initial list of research questions with the potential to significantly advance understanding of mathematical cognition, winnowed this list to a smaller set of priority questions, and refined the eventual questions to meet criteria related to clarity, specificity and practicability. The resulting list comprises 26 questions divided into six broad topic areas: elucidating the nature of mathematical thinking, mapping predictors and processes of competence development, charting developmental trajectories and their interactions, fostering conceptual understanding and procedural skill, designing effective interventions, and developing valid and reliable measures. In presenting these questions in this paper, we intend to support greater coherence in both investigation and reporting, to build a stronger base of information for consideration by policymakers, and to encourage researchers to take a consilient approach to addressing important challenges in mathematical cognition.

Keywords: mathematical cognition, numerical cognition, research agenda, mathematics education

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Introduction

Research on mathematical cognition has made substantial advances in recent years, in areas that span diverse theoretical frameworks both within and across disciplines. For instance, neuroscience research has revealed potential mechanisms contributing to the representation of number and related concepts in the brain (De Smedt, Noël, Gilmore, & Ansari, 2013). Behavioural research has identified distinctive characteristics in the mathematical thinking of young children with atypical development (Dennis, Berch, & Mazzocco, 2009; Geary, 2010; Kaufmann

Alcock, L., Ansari, D., Batchelor, S., Bisson, M.-J., De Smedt, B., Gilmore, C., … Weber, K. (2016). Challenges in mathematical cognition: A collaboratively-derived research agenda. *Journal of Numerical Cognition*, *2*(1), 20–41. https://doi.org/10.5964/jnc.v2i1.10

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Ruth Reynolds	UCL

Timeline

E-A×M+S

MEDA ERME Topic Conference Mathematics Education in the Digital Age

British Society for Research into Learning Mathematics

NE RUME

Online form

- Participants submit their questions

Conference discussions

- GK/IJ presented at conferences
- Gathered comments from attendees
- Also suggestions for new questions

vetted by GK + IJ + CS

Manuscript writeup

- Draft written by GK/IJ/CS
- Shared with WG for comments

Answers!

WG meeting (May 2020)

- Discuss questions in small groups
- Refine wording

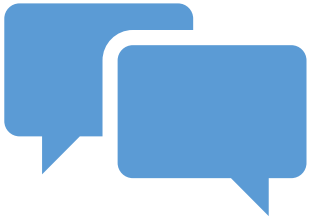
Loose categories formed

WG meeting (Jan 2021)

- Update on progress
- In small groups:
- discussing questions of interest
- starting to edit website content

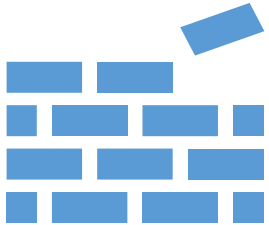
supplement to manuscript

Themes



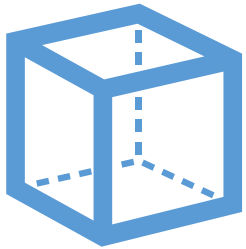
Errors and feedback

Students

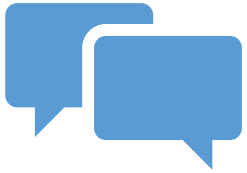


Design and implementation

Affordances



Mathematical skills

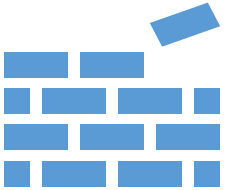


Errors and feedback

- What errors do students make?
- How to optimise feedback design?
- Can automated feedback be improved by emulating teachers?

Students

- How do students:
  - interact with e-assessment systems?
  - engage with feedback?
  - work together?
- What are students' views about e-assessment?

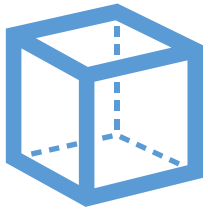


Design and implementation

- Principles for task design – what exists, and what should be used?
- What guidance for lecturers exists, and how effective is it?
- What are the effects of randomisation?

Affordances

- What learning can we assess with current e-assessment tools?
- How can free-form student input be dealt with?
- What capabilities are on the horizon?



Mathematical skills

- How can e-assessment support learning and assessment of mathematical skills?
  - Problem solving
  - Proof
  - Example generation

Themes and connections

Design and implementation

Mathematical skills

Students

Affordances

Errors and feedback

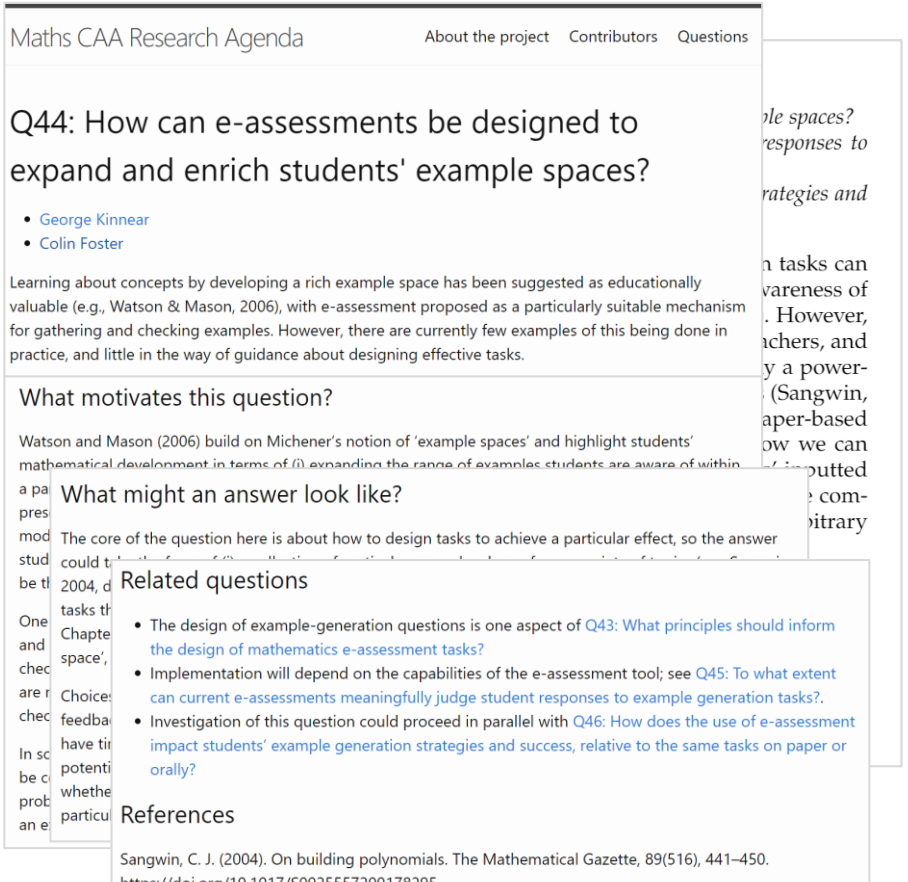
Find out more

Manuscript (in preparation)

- Presents themes, with short description of each sub-theme

Website

- Full details for each question



Thank you!

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