Exploring mathematics education research in the UK and its impact on policy and practice

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An extremely brief geography and history of mathematics education research in Britain

What Britain?

- The United Kingdom of Great Britain and Northern Ireland has four distinct devolved education systems.
- (The Republic of) Ireland has its own education system.
- Compared to England, development of mathematics education research has come much later in the smaller systems.

What research tradition?

- The origins of BSRLM as a society date back to a period when mathematics education research was not just burgeoning internationally but gaining particular influence on policy and practice in England.
- The *British Society for the Psychology of Learning Mathematics* was founded in 1978, shortly after the first PME international conference.
- In 1985 the society was renamed the *British Society for Research into Learning Mathematics.*
- From this we can infer two features of the evolving collective research tradition of this period:
  - A foregrounding of "learning" as the principal object of study.
  - A broadening of conceptual framing beyond the psychological.

The Cockcroft Report and *A Review of Research in Mathematics Education*

- *Mathematics Counts* (1982), was the report of an official committee of enquiry into the teaching of mathematics, known colloquially as "the Cockcroft Report", after its chair.
- The committee commissioned a review of existing research in mathematical education, later published (1983) in 3 volumes:
  - Research on Learning and Teaching
  - Research on the Social Context of Mathematics Education
  - Curriculum Development and Curriculum Research
- It is clear from the Report that ideas and findings from this research had considerable influence on its recommendations.
- These recommendations, in turn, were to have a considerable influence on policy and practice: notably in England, but also more widely around Britain and the English-speaking world.

Continuing but diminishing policy influence

- Looking back, the period preceding and following Cockcroft marks a high point in the influence of mathematics education research on policy making for schooling in England.
- While such research has continued to have a degree of influence, its contribution has been increasingly contested, as highlighted by comparison across the following milestones:
  - Introduction of a national curriculum and national assessment in mathematics (from 1989);
  - Development of a national strategy for systemwide improvement of school mathematics teaching and learning (from 1998);
  - Subsequent revision of national curriculum and assessment (notably the most recent reforms introduced from 2014).
- This reflects not just recurring appeals to "commonsense" and denigration of "experts", but the rise of the alternative frame of school (and system) effectiveness and improvement.

An anatomy of BSRLM today – or yesterday

- To provide a suitably evidenced account of British mathematics education research today, I decided to analyse research reports from the BSRLM informal proceedings for the years 2014 and 2015 (the last complete years available).
- The day conferences from which these informal proceedings derive (held in London, Southampton, Leicester, Dublin, Durham and Reading) represent a reasonable geographical coverage in relation to BSRLM's membership.
- Setting aside a handful of working group reports, exactly 100 research reports were published over this period.
- I have analysed these reports to throw light on:
  - Their provenance and social organisation.
  - Their area of research and orientation to theory.

National provenance – a predominantly English enterprise with a Celtic and international fringe

- The great majority of reports (about 85%) have British authors – very predominantly based in England:
  - 79 were solely by authors based in Britain [England (77), Northern Ireland (0), Scotland (0), Wales (2)].
  - 5 more involved collaboration of authors based in England with overseas authors [Australia, Brazil, Japan, Malaysia, Malta].
- There is some presence of Irish authors:
  - 6 were solely by authors based in (the Republic of) Ireland.
  - 1 more involved collaboration of authors based in Ireland with authors based overseas [United States].
- A modest proportion of reports (around 15%) have authors reporting an affiliation outside Britain and Ireland:
  - 9 were by authors based overseas [Malta, Portugal, Spain, Switzerland, Turkey (3), United States (2)].
  - 6 were collaborations referred to above [Australia, Brazil, Japan, Malaysia, Malta, United States].

Institutional provenance – a predominantly university enterprise with a professional fringe

- The great majority of reports (around 95%) have authors giving a university affiliation:
  - 92 were (solely) by authors giving such an affiliation.
  - 3 involved collaborations between authors giving university and non-university professional affiliations.
- A small minority of reports (around 10%) have authors giving a non-university affiliation:
  - 5 were (solely) by authors from non-university organisations.
  - As indicated above, 3 involved collaborations between authors giving university and non-university affiliations.
  - One author gave both a school and a university affiliation.

Social organisation – more commonly an individual enterprise than a collaborative one

- The sole author/researcher remains the most common pattern (around 60%):
  - 57 reports were sole authored.
- There are appreciable degrees of intra-institutional (around 20%) and inter-institutional (around 20%) collaboration:
  - 15 reports had 2 authors from the same institution, and 8 reports 3 authors from same institution.
  - 20 reports had multiple (2-4) authors from different (2-4) institutions.
- There is a modicum of collaboration between researchers in university and non-university institutions:
  - As indicated by the 3 reports referred to on a previous slide.
- There is a modicum of international collaboration:
  - As indicated by the 6 reports referred to on a previous slide.

Popular research foci – by common keywords

- Specific mathematical topics (around 20%)
  - algebra; arithmetic; calculations
- Teacher professional development (around 20%)
  - teacher + development OR education OR training;
  - professional + development OR learning
- Knowledge for subject teaching (around 10%, small overlap)
  - teacher OR content OR subject-matter OR pedagogical-content + knowledge
  - mathematical knowledge for teaching; knowledge quartet
- Socio-cognitive aspects (around 10%)
  - representation; language; dialogue; talk
- Psycho-social aspects (around 10%)
  - Identity; affect; attitudes; emotions

Reflexivity of theoretical framing

- Less than half the reports are reflexive about theory use.
  - Only 45 make any use of the terms "theory" or related words with the "theor-" stem (some unrelated to the research itself).
- Around 15% of reports are explicit about presenting a theoretical framework.
  - 11 reports include a section headed "Theoretical framework" (or close approximation), and a further 4 indicate through the use of such a term where sections are outlining such a framework.
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  - 11 reports include a section headed "Literature review" (or close approximation), and a further 3 make it explicit that sections are outlining such a review.
- Nevertheless, around 90% of reports make some form of appeal to existing research literature.

Explicit and tacit approaches to theory

- Those reports that appeal to the research literature fall into two groups of roughly equal size.
  - **Explicit theory choice**
    - Reports which single out one (or occasionally two or three) particular named (or marked) theories as guiding the study.
  - **Tacit normal theorisation**
    - Reports which refer to a range of prior research on the topic, and draw on concepts and methods from across that body of work, not singling out any specific theory as guiding the study.

Named/marked theories nominated in reports

- Many of the named/marked theories were nominated as providing/contributing to the frame in only one report.
- Relatively few were nominated in multiple reports.
  - [/] shows use as nominated theory/passing reference.
- The most common were:
  - More generic social and socio-cultural theories:
    - Classical socio-cultural theory (Vygotsky) [4/5];
    - Community of practice (Wenger) [3/2];
    - Cultural capital and habitus (Bourdieu) [3/1].
  - More specific theories of mathematical knowledge for teaching:
    - Knowledge Quartet (Rowland et al.) [5/1];
    - Mathematical Knowledge in Teaching (Shulman/Ball&) [2/7].

Towards an explanatory framework - the British institutional context

- The British pattern has been for mathematics education researchers to be trained in university education departments.
- While some institutions offer a degree of specialist training in mathematics education research, most students follow graduate programmes which are largely or wholly generic.
- Although some students will have studied mathematics at university level, this is not a requirement for admission to, or graduation from, such graduate programmes.
- *A fortiori*, even for a thesis specialising in mathematics education, a doctoral degree can be gained without any formal coursework in mathematics education.
- This means that mathematics education research in Britain is open to wider theoretical and methodological developments.
- But it also inhibits development of an institutionalised intellectual infrastructure for mathematics education research.

British mathematics education research publicly evaluated – The Research Excellence Framework 2014

- Typically, a piece of research will be presented at a BSRLM meeting in its relatively early stages.
- In Britain, a particularly important form of public evaluation of university research takes place through an exercise every 6 or so years to assess its scientific quality and its wider impact.
- Each university unit nominates a portfolio of published research outputs from its researchers, as well as a number of case studies demonstrating the public impact of its research.
- These submissions are evaluated by panels of expert researchers and significant research users (first across education as a field, and then across a wider grouping of social-science fields).
- This gives us useful insights into what is considered to be the best of recent British research in mathematics education.

Summary assessment of the scientific quality of research outputs nominated for REF 2014

- The relevant extract from the narrative produced by the REF 2014 Education sub-panel is as follows:
  - **"STEM education**
  - Overall the quality was strong with most work rated as internationally excellent or world-leading.
  - The best work was characterised by rigorous design, and the use and/or development of theory, to address questions of significance to policy, practice and academic knowledge.
  - For example, where STEM education research interacted with gender, social justice and equality of access to higher education, important work was often produced.
  - Mathematics education was on the whole very strong, particularly in innovative collaborations between mathematics educators and research mathematicians."

Case studies of wider impact of mathematics education research nominated for REF 2014

- **Post-16 participation in mathematics** (King's College London)
  - Research has been cited by government ministers as the basis for deciding to change policy on the study of mathematics in post-16 education. http://results.ref.ac.uk/DownloadFile/ImpactCaseStudy/pdf?caseStudyId=41266
- **Developing and implementing support mechanisms to tackle the 'mathematics problem' in higher education** (Loughborough)
  - Research led to dissemination of a model of Mathematics Support Centres which changed institutional policy and practice at other universities. http://results.ref.ac.uk/DownloadFile/ImpactCaseStudy/pdf?caseStudyId=12389
- **Assessment tools and the impact on learners' 'understanding and use' of mathematics in schools, colleges and higher education** (Manchester)
  - Research improved the design and distribution of educational tests and software, textbooks, teaching materials, qualifications. http://results.ref.ac.uk/DownloadFile/ImpactCaseStudy/pdf?caseStudyId=28150
- **Improving the teaching of mathematics in the United States by using formative approaches** (Nottingham)
  - Research has been taken up by powerful US change agents to improve the quality of teaching and learning in secondary mathematics classrooms. http://results.ref.ac.uk/DownloadFile/ImpactCaseStudy/pdf?caseStudyId=28228

The formalised REF approach is blind to important forms of research impact on practice

- However, the formal rules of the REF game largely disbar recognition of what is probably the most important form of impact of British mathematics education research on practice.
- Most mathematics education researchers work primarily as mathematics teachers and/or teacher educators at university and/or school levels.
- Much of the influence of British mathematics education research is through its dissemination via informal networks such as those provided by BSRLM and the professional associations of mathematics teachers and teacher educators.
- A recurring issue for these associations has been how to extend their membership and influence amongst a wider range of practitioners.

Matters for discussion

- Compare the evolving traditions and contemporary fields of mathematics education research in Britain and France for:
  - Significant common trends
  - Important differences
- Contrast the forms of institutionalisation of mathematics education research in the two traditions – and the training of researchers in particular – with an eye to the affordances and constraints of being institutionally positioned:
  - As a contributory subfield within much broader and more diverse fields of educational and social research.
  - As a more autonomous research field, particularly attuned to what is distinctive about mathematics.