

## GUEST EDITORIAL

## STUDYING THE EVOLUTION OF SCHOOL MATHEMATICS AS A CHANGE IN DISCOURSE

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Parents who are trying to help their children with homework may sometimes wonder whether the tasks currently labelled as “mathematics” really deserve this name. What they see nowadays in school mathematics textbooks in many countries is certainly not the kind of mathematics they remember from their own school days. This difference would probably not appear surprising if it was happening in physics or biology, as we expect scientific knowledge to develop and change over time. It does raise eyebrows, however, when it takes place in mathematics, this special school subject that has traditionally been regarded as universal and immutable – fully resistant to the passage of time.

Some educators are likely to claim that the observed differences are just a matter of a change in ways of teaching, not in what is being taught. These changes, in other words, keep ‘the mathematics as such’ intact. This belief in the separability of form and content also seems to be tacitly present in the oft-heard complaints about ‘falling standards’ in mathematics teaching and learning. Indeed, even when there is decline in student achievement on a given measure (e.g. national examinations, Programme for International Student Assessment (PISA) scores, etc.), deploring this phenomenon is justified only if one assumes that scores from different years are comparable, that is, can be shown to measure learning of the same thing. But can they? And if this assumption is contestable, then how can we approach and evaluate the ongoing change in school mathematics? How is it possible to decide whether the transformations brought about by reforms to curriculum, pedagogy and assessment methods meet their declared goals and constitute a proper response to the needs of present-day society?

These conceptual-methodological questions lie at the core of this special issue, which discusses answers developed as part of the ESRC-funded project *The Evolution of the Discourse of School Mathematics* (EDSM). The aim of this project was to get a better understanding of how school mathematics has evolved over recent decades in England. As the researchers in this project, we decided to investigate this evolution through the prism of the General Certificate of Secondary Education (GCSE) high-stake examinations, taken by all students in England at the end of compulsory schooling. To do so, we needed to develop a method of analysis that would allow us to circumvent the content-form dichotomy, requiring a non-dualist conceptualisation of

mathematics and its learning. Drawing on relatively recent theoretical developments, we adopted an approach grounded in the assumption that school mathematics can be usefully defined as a particular type of discourse.

The focus of this special issue is on the resulting research method and, more specifically, on the analytic scheme for studying the change in mathematics examinations, developed in the EDSM project under the guidance of the discursive framework. The presentation of the scheme in the opening article by the guest editors (Morgan and Sfard) is preceded by the description of the framework, together with its lineage and foundational underpinnings. For each of the questions intended to guide analysis of texts, the EDSM analytic scheme specifies textual indicators with the help of which these questions can be answered. To be conducive to such operationalisation, the questions themselves must be quite different from those asked in traditional comparative studies. Thus, for instance, the researcher who conceptualises mathematics as a discourse does not satisfy herself with asking about mathematical topics covered in the curriculum and does not make distinctions based on the ‘level of difficulty’ at which these topics are taught. The EDSM analytic scheme makes it possible to tie features of examination texts directly to what respondents are expected to do and how they are expected to do it, to how independent they are required (or allowed!) to be in solving mathematical problems, and to stories about mathematical objects they are likely to tell as a result of their exposure to texts like this. Thus changes in the examination text can be translated in a systematic way into changes in the expected forms of students’ participation in mathematical discourse.

The conceptual-methodological article by Morgan and Sfard provides only very brief examples of how the EDSM analytic scheme can be applied. More substantial instantiations are provided in the next two articles, both of which provide glimpses into the methods and results of the study of the evolution over three decades of GCSE examinations. In the first of these, Morgan describes how the project developed analytic tools to characterise the narratives implicated in the examination questions about the role of human agency in school mathematics. She illustrates the application of these tools and presents some of the results of investigation into how these narratives have changed over time. In the next article, Morgan and Tang deal with those aspects of the discourse of examination that justify describing it as mathematical. More specifically, they investigate the extent of specialisation of the mathematical discourse with which the students have been expected to engage at different times, identifying changes in engagement with algebraic manipulation, proving, relating mathematics to non-mathematical context and making connections between mathematical objects. Aware of the fact that almost any mathematical narrative about processes may be translated into a story of mathematical objects and their properties, the authors ask about the degree of objectification of the text. The question is important, because in mathematics, objectification of the current mathematical discourse is often

required before a new discursive layer can be built, and thus before further progress can occur. In both these articles, the results of the analyses show that very subtle textual differences, likely to be unnoticeable to any mathematically versed person, may nevertheless be significant enough to affect students' vision of mathematics as well as their performance and, eventually, their ability to cope with problems that can benefit from the use of mathematics.

The remaining two contributions make it clear that the significance of the conceptual-methodological issues discussed in this volume goes beyond the particular context within which they originally arose. Alshwaikh illustrates this claim by adapting the EDSM method to his study of Palestinian mathematics textbooks. He focuses on two types of challenge faced by the researcher who tries to adjust an analytic method to new contexts. First, Alshwaikh seeks to deal more thoroughly with the visual elements of geometry chapters in the textbooks, finding that adjusting the scheme in order to capture additional aspects of text may be a matter of adaptation of the scheme rather than of its straightforward extension. Second, there are challenges related to translating the scheme from one language to another. In the case of Arabic, with its written language quite different from that used for everyday communication, the problem seems particularly acute. Lerman and Adler put the themes pursued in this special issue into a broader context when they argue in their concluding paper that research is but one among many factors that contribute to shaping educational policies. Politicians, professional decision-makers and critics voicing their opinions through the public media are probably more influential than researchers.

The invited commentaries from Beth Herbel-Eisenmann and Margaret Brown provide further reflections on the methodology, findings and implications of the EDSM study. Herbel-Eisenmann discusses some aspects of research quality that have not been fully addressed in the articles within this Special Issue. These suggest approaches to further enriching the EDSM research and point to the need to attend carefully to its possible consequences. Brown's commentary demonstrates that a discursive approach can provide insights for those who normally adopt a cognitivist perspective. She highlights some of the findings reported in the three EDSM articles that she sees as particularly interesting, setting an agenda for practitioners (both teachers and examination writers) and policy makers as well as for researchers. Brown also supports Lerman and Adler's identification of a need for 'public intellectuals' to provide research-informed advocacy in public debates about education.

This special issue, and the research project in which it has its roots, is an attempt to make research in mathematics education more relevant to school practices. Whereas references to research are an inextricable part of educational rhetoric, the real impact of such research has been, so far, debatable, to say the least. In particular, although all parties involved in the current

debates about ‘falling standards’ make extensive use of the phrase ‘as shown in research’, the actual scientific evidence for the claims made in these debates is usually scarce and unreliable or is interpreted in ways that have dubious validity. One of the reasons for this marginality of research lies in the research itself, in the fact that methods used in studies that feed into the conversation are often neither operational enough to produce defensible insights nor sufficiently refined to allow for identifying phenomena relevant to the claims that are being made. It is this need for more informative and reliable ways of seeing and investigating the change over time in school mathematics that this special issue is responding to.