Book Chapter

The development of mathematics education as an academic field

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Abstract

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The Development of Mathematics Education as an Academic Field (Reaction to Jeremy Kilpatrick's lecture)

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Academic? You said academic?

I will start my task as non-native-English-speaker reactor by tackling the question of language, even though Jeremy, as a "fin connaisseur" of Europe and France especially, has already raised this issue. Indeed, my first reaction, after reading Jeremy's paper was to look in a dictionary not for *mathematics education* or *didactic* but first for the definition of *academic*.

Here is a brief synthesis of my search:

- In the *Concise Oxford English Dictionary* (2006)

Academic → adj.
1. relating to education and scholarship. • scholarly rather than technical or practical.
2. (of an art form) conventional in an idealized or excessively formal way.
3. not related to a real or practical situation and therefore **irrelevant.**

Scholarly → adj.
involving academic study or dedicated to academic pursuits.[1]

- In the *Oxford American Thesaurus of Current English* (1999)

Academic adjective 1. *academic considerations* educational, scholastic, instructional, pedagogical. 2. *of an academic turn of mind* scholarly, studious, literary, well-read, intellectual, erudite, learned, cultured, bookish, highbrow, pedantic, professorial, cerebral; inf. brainy. 3. *an academic rather than a practical solution* theoretical, hypothetical, abstract, conjectural, notional, impractical, unrealistic, speculative, ivory-towerish.

Scholarly adjective learned, erudite, academic, well-read, intellectual, scholastic, literary, studious, bookish, lettered; inf. egghead, highbrow. opposites: illiterate; ignorant.

Therefore the issue of mathematics education being an academic field has to do not only with a structural aspect of research (as mentioned by Jeremy) but also with the question of the legitimacy of a theoretical positioning about issues within the scope of mathematics education.

From the definitions above, it turns out that 'being academic'—like 'being didactic'—is often judged as rather negative, 'excessively formal', 'not related to real or practical situation', even 'pedantic', ivory-towerish', 'unrealistic' and 'impractical'—and this is not just specific to the English language. Therefore, why would mathematics education struggle to be an academic field, rather than just a practical matter relevant to the reality of teaching? Is there any space for theory in mathematics education, or is it just a field of action and practice?

[1] Interesting circular definitions.

Social relevance of mathematics education

In several countries today, education and teacher training are problematic political issues, subject to a crisis, whose importance is still difficult to evaluate, especially because these issues take different aspects throughout the planet. The democratization of education is one of the biggest challenges that education has had to face in decades and maybe even centuries.

Jeremy noted that the two crucial dates of 1908 and 1952 in the history of ICMI, both "marked the beginnings of periods when school curriculum was being faced with new demands". However, 1908 and 1952 also opened periods of hopes (dreams?) for a better and more democratic teaching of mathematics. Even if the period of 'modern math' was subject to sharp criticism afterwards, the counter-reform that started in the 1980s was still a period of enthusiasm that led to a large development of research work in all fields of education. In contrast, it seems that the turn of the 21st century was more pessimistic, and we are now facing this paradox that, while research in mathematics education has never been so developed and allows us to know much more about the teaching and learning of mathematics, it is politically attacked and accused of being irrelevant in many countries. Conservative viewpoints are getting more and more popular: "a good teacher is someone with a gift, a vocation, and (eventually) a good training in mathematics (there is no need for all the theoretical mess that trainee teachers are fed by pedantic scholars)"; "a child needs above all to know his or her fundamentals, like algorithms for basic operations"; "pocket calculators should be banned"; and so on.

Should we see here signs of the failure to make mathematics education a socially efficient academic field? Or are these negative comments just a side effect of a general distrust of academic intervention coupled with a global crisis touching the social status of school and education?

Mathematics education cannot answer this question, but the academic development of this field is somehow dependent on its ability to react to the new social challenges. This is not just a demagogical issue, but really an epistemological one. If we follow this argument, it is therefore interesting to analyze the evolution of mathematics education as an academic field during the last century in terms of responses to the social evolution of education as well as the evolution of mathematics in society.

The increasing importance of mathematics from the beginning of 20th century

In 1908, our starting point, in most countries, education was mostly provided to boys coming from the upper levels of society. The curriculum changes happening at the beginning of the 20th century were the result of the evolution of sciences in the preceding century and their role in society.

> Besides the claimed necessity to take into account the training of all kinds of elites, including those of industry and business, another reason is the importance of the positivist context of the end of the 19th century, when the status of the sciences was raised to that of the humanities. (*My translation from* (Gispert, 2002), p. 159)

In this movement, the place of mathematics in education was to be totally transformed. Carlo Bourlet's address at the meeting of the recently created CIEM during the *Exposition Universelle* in 1910 in Brussels gave a good overview of the situation:

> Modern teaching cannot be limited to the training of faculties of the brain; it must show how to fill it with facts, numerous and precise. We do not have to train philosophers who will live like erudite hermits, but men of action who will have to contribute their share to human progress. That is why we can no longer just present to our students mathematical science in a purely speculative way. We must at all costs serve the whole of society, so that with each one of our students specifically, we do our best to make mathematical abstractions yield to the necessities of reality. (*My translation from* (Bourlet, 1910), p. 374)

As a consequence, Bourlet advocated a radical change in the curriculum, bringing a new face to mathematics teaching:

> Let us put the antique Euclidean edifice, admirable for its harmony and perfection, away with historical monuments and build, according to a new schema, a homogeneous work consistent with today's necessities. (p. 384)

However, no major changes occurred in the social structure of school.

Therefore, the movement to which the creation of the CIEM in 1908 gave an international dimension called for a general reflection about the nature of mathematics to be taught and how to organize its teaching. As a consequence, a need for teacher training followed. Several mathematicians from different countries and status participated in this reform, creating a first step towards the constitution of mathematics education as an academic field, within the mathematical circle, with contributions from the Didaktik or curriculum traditions depending on national traditions (see, e.g., Hopman, 2007, and Hudson, 2007).

Modern mathematics and the democratization of education

The second important event of the 20th century regarding mathematics education corresponds to the reform of modern mathematics, whose first signs appeared in the 1950s. This reform brought not only important changes in the content of mathematics teaching but also a first democratization of education as well as a reflection about new ways of teaching, initiated by several pedagogical movements and research work from psychologists in different countries. Mathematics and sciences were to be renewed in their content and objectives, but also to be taught to a larger portion of students as part of their training as citizens and not only to the elite. That is what André Lichnérowicz (president of CIEM, 1964–1966) expressed in the introduction of the report of the commission he directed that settled the reform in France in 1967:

> In order to feel like a full citizen of human society, a man of the second half of the 20th century must know how to locate himself in space and time, must communicate with foreign communities, but must above all perceive some methods for thinking and acting in what constitutes the know-how of today's science and technique. (*my translation from the quotation in* (Gispert, 2002), p. 160)

Therefore mathematics education was to broaden its means and scope and not only reflect on curricula, a demand that Hans Freudenthal (president of CIEM 1967–1970) already expressed in 1963:

> Since its origin at the beginning of this century, CIEM has mainly been busy with organizing mathematics teaching in different countries, including current and prospective curricula and examinations. History has proven the sterility of purely organizational issues (*My translation from* (Freudenthal, 1963), p. 29)

He clearly put forward the issue of the social evolution of education and claims for a

more didactical orientation, also referring to research in psychology:

> The social implications of education have changed a lot during the last decades. The educational task evolves more and more from the transfer of cultural acquisitions to the initiation into cultural activities. …The educational psychologists know how to show why understanding new subjects is deeper and more longer lasting if it is of a reinventing nature. (p. 31)

Indeed, from the 1950s, research in mathematics education developed new ideas, paradigms, and theoretical frameworks. This evolution took different aspects throughout the world, but the general tendency was to develop research that took into account cognitive and psychological aspects in the teaching and learning processes. Piaget's and Vygotsky's work (to cite only the most famous) were important sources of inspiration. Nevertheless, mathematics education developed specific theoretical frameworks in which mathematics was still central. In France, for instance, both Brousseau's and Vergnaud's contributions were original in that sense.

The CIEM had an essential role in the international cohesion with, in particular, the first International Congress on Mathematical Education, held in Lyon in 1969, the formation of the Psychology of Mathematical Education affiliated group in 1980, and the ICMI Studies beginning in 1985. It would be too much here to give details, but the evolution in content of these different international meetings of the mathematics education community gives an overview of the large variety of subjects and methods developed and discussed since the 1960s.

A more complex surrounding for mathematics education

I do not have space here to analyze the key points in this evolution in the light of social changes in education and the role of mathematics in society. Important issues like teacher training, teaching in difficult social contexts or multicultural environments, the development of new technologies, the decreasing social value attached to mathematics, the competence-versus-content orientated curriculum reforms, and so forth led researchers in mathematics education to develop new theoretical frameworks in order to tackle these questions. Cultural differences between countries have also emerged that sometimes make communication within an international community difficult. Jeremy developed this point while discussing the difference between *didactique, didaktik, mathematics education, pedagogy,* and so forth. Beyond language, these differences bring to light differences in research paradigms and theoretical frameworks. There are also differences in national educational policies that international surveys like PISA reveal or even exacerbate from time to time.

In the meantime, research in education has led to the constitution of an academic field that is of greater or lesser importance in different countries. The relations that mathematics education hold with this field are varied, depending on different contexts in every country. In some countries, the possible space for mathematics education, as an independent academic field between education and mathematics may be problematic (in various ways) on both institutional and epistemological grounds. An interesting issue is that this situation can have different aspects for mathematics than for other school subjects (like literature, sciences, or history) even in the same country (see, e.g., Sarremejane, 2001). On the other hand, mathematics education has developed several types of cooperation with other academic fields in relation to education because the development of research shows that the complexity of the reality of education needs to be

tackled from different viewpoints. However, in this diversity, it is also important that mathematics education be able to put forward the specificities of its objects, methods, and epistemology. In that sense, the relation to mathematics is essential, and the role of ICMI is thus vital in order to maintain and develop in all its variety an academic field specific to mathematics education that maintains a privileged relation with the mathematical community at large.

Issues of education are more and more subject to political, cultural, and social contexts. The traditional organization of school subjects, the role of mathematics for other sciences, in society in general and in education in particular, and the social constraints of education are among the crucial questions that mathematics education has to take into account. Since 1908, the situation has changed in many ways. Research in mathematics education has tremendously enlarged its scope and means, but mathematics education is also subject to more social pressure. A risk would be that it fails to qualify as an independent academic field because it cannot ensure a consistent and original domain and is absorbed in related fields. A barrier against this possible dilution remains the attachment of mathematics education to mathematics that ICMI can guarantee while encouraging cooperative work with other academic fields connected to education.

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