

TOWARDS QUALITATIVE AND PARTICIPATORY RESEARCH ON THE HISTORY OF MATHEMATICS IN MATHEMATICS EDUCATION

DAVID GUILLEMETTE

Relationships between the history of mathematics and mathematics education have long been developed and discussed. Within research, these relationships have been explored particularly by the *International Study Group on the Relations between the History and Pedagogy of Mathematics (HPM Study Group)*. Affiliated with the *International Commission on Mathematical Instruction (ICMI)*, the HPM Study Group seeks to connect the history of mathematics as a discipline, its roles in education, and the roles that it continues to have in developing mathematical instruction and curricula.

Within the HPM literature, many arguments have been put forward for a more explicit introduction of the history of mathematics in the classroom. It is now quite well established that engaging learners with the history of mathematics may provide a sense of ‘unfamiliarity’ (Clark, Kjeldsen, Schorcht, Tzanakis & Wang, 2016). This phenomenon is also referred to as ‘disorientation’ (Guillemette, 2017) or ‘dépaysement’ (Barbin, 1997; Guillemette, 2017). As happens when a person finds themselves in a foreign context, after a phase of confusion and perplexity, attempts to reconstruct meaning emerge. The educationally reward of such an experience is that learners become more inclined to keep an open mind in relation to mathematical concepts and that they reflect on the nature of mathematics itself.

The disorientation power of history could lead to a more cultural understanding of mathematics by inviting historical-anthropological reflection on mathematical activity and a repositioning of mathematics as a genuine human endeavour. For teachers, it could be a source of pedagogical and didactic reflection by questioning both the epistemology of mathematics and usual teaching practice. It could also inspire history-based classroom activities such as exploring historical texts or artefacts, snippets, or historical problems.

This said, despite many theoretical and practical developments [1], some major issues are still being discussed and are felt keenly by HPM researchers. In the proceedings of the 2016 HPM meeting, Clark *et al.* (2016) mention four issues that are currently central: (1) to put emphasis on pre- and in-service teachers’ education, (2) to design, make available and disseminate a variety of didactic source material, (3) to perform systematic, careful and applied empirical research in order to examine in detail and evaluate convinc-

ingly the effectiveness of the HPM perspective and (4) to acquire a deeper understanding of theoretical ideas put forward in HPM to develop them into coherent theoretical frameworks and methodological schemes.

These issues can be linked to those more recently raised by Barbin, Guillemette and Tzanakis (2020). They mention the need for (1) common ground between history of mathematics and mathematics education, (2) effective theoretical and conceptual frameworks, (3) more in-depth empirical studies and (4) a more refined reflection around the interdisciplinary role of the history of mathematics (p. 340).

We can observe two convergent and recurrent claims: the need for more in-depth empirical studies and the need for theoretical or conceptual frameworks. Here I will try to show how these two needs can be seen as two faces of the same coin and formulate some possible paths for research to address these issues as one.

The need for empirical research and theoretical frameworks

As introduced above, the history of mathematics has an important potential to develop and refine learners’ relation with mathematics, particularly in terms of epistemology, as well as cultural anchoring and relationships. Regarding this potential, Jankvist (2009) noted the low number of empirical studies in comparison with theoretical studies. He echoed an argument made by Siu and Tzanakis at ICME-10, that there is a need for more “empirical evidence of the effectiveness of the use of history” (p. 69). The idea here is to give up optimistic and propagandist rhetoric and to go for more research-based, critical and empirically based discussions. Empirical studies often take the form of (generally positive) practical accounts, which, beside interesting activities and initiatives, do not shed much light on the understanding of the potential of the history of mathematics in terms of research. In other words, there is a need to unpack and to make explicit the ways in which teaching and learning mathematics have been articulated with historical elements and to make explicit the different roles that it can have for the learning of mathematics.

Regarding theoretical studies, Fried, Guillemette and Jahnke (2016) have suggested elements of what a proper

theoretical and conceptual framework in the field should be made of, and what fundamental reflections and positioning it should minimally bring. To summarize their point, such a framework should at least address the questions: Why we ought to learn history or historical elements related to mathematics? What part of learners' intellectual life is touched by history? Moreover, our own view of mathematics, of the past, should be problematised by considering and theorising learners, educators, and researchers' relation to the past. Such frameworks are still needed, as 'usual' mathematics education frameworks do not explicitly address these fundamental positioning regarding history, and are, therefore, difficult to operationalise in research. Incidentally, this could explain the common ground between mathematics education and history of mathematics.

Possible paths for research

For now, we can observe, on the one hand, that theoretical research provides important insight into the potential of the history of mathematics, but sometimes takes the form of propagandist rhetoric. On the other hand, empirical research describes interesting initiatives, but without being grounded in proper theoretical frameworks coming from the field. We can conclude that both theoretical and empirical studies seem to walk side-by-side, having a hard time stimulating and informing each other. This is why I prefer to see these two needs as two faces of the same coin.

The search for common ground between mathematics education and history of mathematics—at the level of *epistemology*—seems to be a promising direction. I would like to show here how some possible answers and solutions could also be found at the level of *methodology*. I will argue that specific developments of qualitative and participatory research could help to dynamise this dialectic between theoretical and empirical research in the field.

Qualitative research on the introduction of the history of mathematics

Qualitative research is broadly based on an interpretive or comprehensive paradigm, driven by the desire to better understand the meaning of individuals' reality and the meaning that they, themselves, give to their experiences. It produces conceptualisations that are legitimated by researchers' and participants' experiences that have been carefully described. On the one hand, these conceptualisations could enrich theoretical research. On the other hand, this legitimacy could then encourage empirical research to draw on this theoretical research and to take their developments into account in the form of conceptual frameworks, theoretical frameworks, or frameworks of analyses.

The hermeneutic approach in research is an example of qualitative approach that has shown a real potential in the field (see Fried, Guillemette & Jahnke, 2016). The focus here is on how the students learn something about their own mathematics by experiencing and "reflecting on the contrast between modern concepts and their historical counterparts" (Fried, Guillemette & Jahnke, 2016, p. 218). This approach carries the concept the 'hermeneutic circle', a process in which a hypothesis is put up, related to what the student is confronted, tested against the source by confronting it with

other parts of the text, modified, tested again and so on, until the reader arrives at a satisfying result after a kind of saturation of meaning. The description of this process could show how the students deepen both their understanding of history and of their own set of modern conceptualisations regarding mathematics and mathematical objects.

This is why I think that the hermeneutic approach is interesting as it could help to dynamise the creation of conceptualisations, which could enrich theoretical research, and create, as introduced above, an emulative movement between empirical and theoretical research.

The potential of participatory research

Another way to dynamise the dialectic between theoretical and empirical research is to develop participatory research in the field. By bringing together research findings and teachers' expertise, participatory research aims to better understand and support practice. Within a collaborative process, conceptualisations regarding the role and potential of history in mathematics education could be discussed and find a kind of double legitimacy coming from both participants and researchers. These conceptualisations could again enrich theoretical research, and also encourage further empirical research to draw on this theoretical research.

Elsewhere, Luis Radford and I developed a dialogical/ethical approach (Guillemette, 2019; Guillemette & Radford, 2022), in the field of research. This approach brings fundamental concepts and ways of conducting research that could help to think about, and include in the process analyses, different 'voices', voices from the researcher and the participants, but also *voices from the past* that are invoked when engaging with the history of mathematics.

Based on the dialogic principle developed by Mikhaïl Bakhtin, we perceive the engagement with the history of mathematics as the meeting of two subjects in an emergent dialogue. But this dialogue is not understood at the level of concrete exchange, but rather on the intrinsically tied levels of ideas and ways-to-engage-in-the-world. On this basis, the exploration of the role and potential of the history of mathematics would reside in the restoration of the acts of meanings that emerged in this *dialogical interaction*. There is room here for casting a descriptive, reflective, and critical stance towards how this engagement and interaction could challenge teachers', learners', and also researchers', own ideas and expectations.

Conclusion

In this short communication, I discussed the claim for more in-depth empirical studies and proper theoretical or conceptual frameworks on the potential of the history of mathematics in mathematics education. I highlighted the need for a dynamisation between empirical and theoretical research and thus argued that these two claims could be seen as two faces of the same coin. In this quest, I emphasised especially on methodology, and described and suggest particular ways to conduct qualitative and participatory research in the field. I also hope to have aroused the curiosity of the community about an interesting subject full of potential.

Note

[1] See Barbin *et al.* (2020) and Clark *et al.* (2016) for further discussions.

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