IMPACT OF THE USE OF HISTORY IN SECONDARY SCHOOL MATHEMATICS EDUCATION: AN EMPIRICAL STUDY

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ABSTRACT

Within a recent French reform (2019), the history of mathematics (HM) is mentioned in the students' curriculum (from grade 10 to grade 12). Through an overview of the curriculum and textbooks, a gap emerges: a need to create activities that perceive history as a goal in itself addressing concepts prescribed by the curriculum.

My research questions at this stage are: 1) What are students' perceptions of mathematics before HM introduction? 2) How does this perception change as the activities progress? 3) Does working with activities specifically designed in collaboration with researchers and teachers to meet everyone's expectations lead to increased motivation, in the sense of perseverance to complete the task? Will the students choose to pursure further studies of mathematics at the end of the school year ("long-term" motivation)? At the end of this article, we will describe how our activities, which will be used for data collection in 2023-2024, convening of the history of mathematics are created.

1 Introduction: a reform context

French education has undergone a major reform, implemented at the start of the 2019 school year. As we can read in this extract from the official bulletin (OB)⁴⁹: *«The problems proposed to the students can be internal to mathematics, [or] come from the history of mathematics [...]. In all cases, they must be well designed and motivating, in order to develop mathematical knowledge and skills of the programme».* The new syllabus suggests the use of HM in the class and seeks to motivate the students. France is not isolated, the introduction of HM in the students' curriculum concerns many other countries (Charbonneau, 2006; Jankvist, 2010; Halmaghi, 2013). Now in France, after grade 10 (15-16 years), students can choose whether or not to continue with mathematics. They have the common modules including science (2 hours per week) and three (out of 13 proposed) specialised subjects to choose from, including mathematics. In a report by the national statistical service in March 2022, a comparison is made between the system before and after. They considered that *« mathematics is not, or not sufficiently*,

⁴⁹ The implementation of ministerial measures of national education are the subject of regulatory texts called official bulletins.

taught in the framework of science ». It is mentioned that today 36% of the pupils did not do mathematics in the grade 11 (16-17 years old) against 13% in the old system.

Many research studies have suggested that the use of HM can improve students' learning outcomes in cognitive and affective domains (e.g. De Vittori, 2022; Fauvel, 1991; Lim and Chapman, 2015). Others have advocated the inclusion of this practice in national curricula (Fauvel and Van Maanen, 2000) and in teacher education courses (Charalambous, Panaoura and Phillippou, 2009; Clark, 2012; Guillemette, 2017).

The OB of National Education revised the integration of mathematics teaching into the science curriculum for grade 11 (16-17 years old) on 07/2022. It specifies its major intentions: the consolidation of the mathematical culture of the students, situating mathematics within its social context through the insertion of elements of HM and science.

Finally, the secondary school final examination (Baccalaureat) has been modified. From now on, students have to take a « grand oral » (big talk) on a topic related to the speciality teaching they are taught by. For this, each teacher has to work on the oral with their students. How to work on oral expression in mathematics? Lim and Chapman (2015), Perkins (1991) and Siu (1997) suggest that stories about mathematicians could be used to engage students in mathematics lessons. All these works, show a willingness of research and institutions to use HM in the classroom.

2. The integration of HM in the classroom.

Despite the institutional demand and research showing its potential interest, teachers rarely provide students with the reading of a historical text, a historical problem, the history of a concept or a mathematical tool, limiting themselves to using HM in the form of anecdotes, 'story bites' (in the sense of Tzanakis, 2000) to introduce a teaching sequence (Moyon, 2022). Moyon explains that teachers rarely use HM to establish a proof, to show the usefulness of mathematics, or for training exercises. Very few of them use HM for presentations or biographies (2%) and during homework (1%). Moyon concludes: *« Although it is comforting that mathematics teachers are willing to introduce a historical perspective in their teaching, the fact remains that there is still a long way to go»*. So, according to Moyon teachers *« suffer from a lack of didactic expertise in this area » and « a lack of historical knowledge »* (p.4).

Moreover teachers are not convinced that HM can lead to better learning outcomes (Fauvel, 1991; Gulikers and Boom, 2001), or that reading historical texts can help students to better understand mathematics (Moyon, 2022)

Yet most studies testing the effectiveness of HM in improving achievement (Clark, 2012; Gulikers and Boom, 2001) suggest that the use of HM improves students' learning outcomes in the cognitive and affective domains.

Lim and Chapman (2015) showed students in the experimental group felt more motivated to learn mathematics than those in the control group, but, the post-test indicated that this effect was time-limited. Bütüner and Baki (2020) explained that students' perceptions changed after the implementation of activities related to the history of mathematics. There is a real need to understand this phenomenon better. Several researchers ask more empirical study (HPM⁵⁰, Clark & al (2018))

In my thesis, I will only focus on the affective part and in particular on the motivation (or not) of students after their teachers' use of historically supported activities. I will study several 10th grade classes (15-16 years old) when faced with tasks involving HM. For this purpose, several activities will be created and then tested. I have chosen this level in order to observe if there is an impact on the choice to continue mathematics⁵¹ the following year or not.

At this stage of my explorations my research questions are:

- 1) What are the students' perception of mathematics before the introduction of HM?
- 2) How do these perceptions change as the activities progress?
- 3) Does working with activities specifically designed through collaboration between researchers and teachers lead to increased motivation, in the sense of perseverance to complete the task? What about motivation at the end of the year?

I am also interested in the teacher's perception of their class. Will their feelings about the motivation of their students be in line with the students own perceptions of their motivation?

For my research, activities will be designed in a collaborative mode in order to best fit with the prescriptions of this French curriculum. The researcher first creates a draft activity which is reviewed by historians of mathematics and didacticians of mathematics. It is then modified a first time. Then it is submitted to

⁵⁰ the International Study Group on the Relations between the History and Pedagogy of Mathematics

⁵¹ In the context of the French reform described above

teachers and reworked a second time. This second version is tested on classes and a first feedback from teachers is made. This second activity and this feedback are discussed with historians of mathematics and didacticians in order to provide the final version of the activity which will allow me to collect data and carry out my study.

3. Conclusion

Data collection is planned for the academic year 2023-2024. I hope that this research can help teacher practice and inform research on the impact of the introduction of HM on secondary school mathematics classes. Activities created may be reused later for further or initial training.

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