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Social and political issues in mathematics education: An overview of an ongoing participatory research with in-service secondary school teachers

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In this paper, we present an overview of a study on social and political issues in mathematics education in the context of secondary school mathematics teaching. The study takes the form of participatory research in which teachers and researchers come together to reflect on these issues. The purpose is both to document the didactic and pedagogical reflections of secondary school teachers and to support their practice. A group of four teachers engaged in this collaborative process was formed, and three collaborative meetings were organized. We present here an overview of the study, emphasizing problematizing elements, objectives, and methodological developments. Preliminary results on how teachers acknowledge and engage with social and political issues, various ways of developing tools that emerged, and difficulties encountered are presented.

Keywords: Participatory research, in-service teacher practices, social and political dimensions of mathematics education, dialogism, dialogical approach.

Problematizing elements

As in any human activity, mathematics has both a social and cultural dimension. A close examination of the history of mathematics shows us that mathematics is practiced in a specific context and that it responds to the needs of the societies and cultures that influence its orientation and implementation. Thus, through different mathematical practices, such as problem solving, modeling, and constructing proofs, a whole set of attitudes and ways of being in the world are called upon and contribute to anchoring mathematics in the social and cultural realm.

“Sociocultural” and “critical” approaches to mathematics education attempt to highlight these dimensions of mathematics and mathematics education, and to explore and promote teaching and learning along these lines (see Adler et al., 2005; Skosmose, 2012). They are called “sociocultural” because they are grounded in a social and cultural perspective of teaching and learning, but also “critical” because they highlight or underline forms of governmentality, domination, and the dynamics of alienation in the context of mathematics education.

Increasingly, social, political, and cultural issues are no longer peripheral but have become central to thinking about mathematics education. For example, in 2014 in the United States, a major survey by the National Council of Teachers of Mathematics (NCTM) was conducted among researchers, instructors, and elementary and secondary teachers across the country. The survey highlighted three

major challenges that strongly drive the community: 1) changing perceptions of what it means to do mathematics, 2) changing public perceptions of the role of mathematics in society, and 3) achieving equity in mathematics education (Stephan et al., 2015). As a result, the need to consider social and political dimensions and to broaden the spectrum of pedagogical reflection and discussion has emerged in the mathematics education research and practice communities.

Specifically, the social and political issues that appear most crucial today are 1) social justice, 2) equity, diversity, and inclusion, and 3) various environmental threats (see Subramanian, 2019). The issue of social justice seems central, since economic and cultural inequalities are widening and creating unsustainable social tensions and exclusionary dynamics, in addition to unprecedented environmental problems. We believe that mathematics education is not neutral in front of these issues and that the mathematics education community needs to think urgently about how it can contribute to addressing these critical contemporary challenges. For us, and for many researchers nationally (e.g., Barwell, 2012; Nicol & Jovanovich, 2011) and internationally (e.g., Ball, et al., 2005; Nasir & Cobb, 2007), the development of educational sensitivity to the diversity of values and ways of being in the world that mathematics can summon in relation to these issues seems paramount at this time.

That said, despite the effervescence of the research community and the publication of numerous large-scale studies (e.g., Atweh et al., 2011; Rubel, 2018), empirical research on the topic remains scarce in the French-speaking world and among in-service teachers (Guillemette & Nicol, 2016). Two types of studies are generally observed. On the one hand, research based on questionnaires and interviews asks teachers how they intend to address social and political issues in their classroom (e.g., Mintos et al. 2018). On the other hand, research based on classroom observations has described the effects of introducing learning situations that address social and political issues (e.g., Esmonde & Caswell, 2010). In both cases, teachers were identified as being interested in these issues, but reported being poorly trained and lacking in pedagogical resources that could be mobilized in the classroom, citing lack of time and the difficulty of following the curriculum when considering these issues (Guillemette & Nicol, 2016).

In the end, we still do not know in any great depth the constraints and issues that hold teachers back. Nor do we know, firstly, teachers' perceptions of these issues and how they can really be expected to apply their professional skills to develop tools for their practice. Indeed, current research has yet to give voice to in-service teachers regarding these issues and successfully develop research to examine these issues in detail (Guillemette & Nicol, 2016; Mukhopadhyay & Roth, 2012). In sum, a twofold problem emerges, that of better understanding the relationship in pedagogical and didactic terms that teachers have with social and political issues, and supporting practice by making research developments on the subject accessible to teachers while taking into account the constraints experienced in the mathematics classroom.

The context of Quebec, Canada

In addition, social and political issues are now strongly emphasized in teacher education programs. In the province of Quebec (Canada) the new *Référentiel de compétences professionnelles : profession enseignante* [Professional skills framework: Teaching profession], in reference to a new cross-disciplinary skills set, explicitly states that teachers must act as ethical professionals with respect to

diversity (Gouvernement du Québec, 2020). It is specified that "... on the part of teachers, acting ethically also implies adhering to a certain number of dispositions (attitudes or values) that influence how they carry out their duties" (our translation, Gouvernement du Québec, 2020, p. 81). It is mentioned that "socioeconomic inequalities challenge schools and teachers in their ability to promote equity and inclusive education by using the levers of intervention available to them in a social justice perspective" (p. 17). These expectations weigh heavily on the shoulders of mathematics teachers.

Research questions

Given these problematizing elements, we pose these research questions: How do secondary school mathematics teachers intend to meet these expectations? How can research knowledge be mobilized to support their practice while considering the constraints and difficulties experienced and expected?

Theoretical positioning

Our approach is rooted in a cultural-historical perspective of mathematics education (Radford, 2011, 2021). In this perspective, the classroom is perceived as the meeting place between the subject and the object of knowledge, and the objectification that allows this meeting is an eminently social process. However, based on the notion of "otherness" developed by the philosophers Mikhail Bakhtin and Emmanuel Levinas, the sociality of the learning process does not simply mean that learning is made up of social relations, but means the formation and transformation of consciousness – which is precisely (con)science, i.e., "knowing in common" or "knowing with others."

Therefore, the mathematics classroom activity cannot be perceived as a game of controlling variables with a view to optimize cognitive and material resources. Rather, our perspective suggests that the classroom offers "ways of being and knowing depending on how students engage as a group in their quest for the intended cultural knowledge" (our translation, Radford, 2011, p. 15). Learning mathematics is thus understood as a social process of gradual awareness of historical-culturally mediated knowledge through which individuals' consciousness is formed and transformed. This puts the ethics at the very core of mathematics education, that is, conceived as a "political, societal, historical, and cultural endeavour aiming at the dialectical creation of reflexive and ethical subjects who critically position themselves in historically and culturally constituted mathematical discourses and practices, and who ponder new possibilities of action and thinking" (Radford, 2021, p. 228).

Research objectives

Within this theoretical framework and having in mind the problematizing elements discussed earlier, we formulated these research objectives: 1) document the epistemological, didactic, and pedagogical reflections of secondary school teachers around social and political issues in mathematics education, 2) describe how didactic and pedagogical tools are developed for their classroom through jointly produced activities, and 3) describe their experienced and apprehended constraints and problems.

Methodological framework

Our objectives were oriented towards both the production of knowledge for research and the support of secondary school teacher practices. This prompted us to adopt a participatory approach (Desgagné, 2007). These approaches generally find their roots and epistemological influences in social

constructivism and ethnomethodology. However, we believe that it is necessary to adjust our methodological framework to our theoretical position in mathematics education, which does not concur with, or at least easily align with these influences.

A dialogical perspective

Although we have achieved a certain degree of alignment by basing our methodological framework on a dialogical approach (Abtahi & Barwell, 2019; Guillemette, 2017, 2021), this approach is based on the concept of dialogism developed by the philosopher Mikhail Bakhtin (1895-1975). It emphasizes that each utterance in discourse is necessarily a response to other utterances in a given sphere of communication. Discourse is then perceived as inevitably embedded in a dialogue, but this dialogue is not the simple sequence of statements constituting a form of exchange or conversation. These aspects would only be the superficial manifestation of dialogism. More generally, we are referring here to dialogue both at the level of language and at the level of ideas and ways of being. For Bakhtin (1981), when we speak, we invest ourselves subjectively: no word can be uttered without an evaluative accent, without an attitude or mode of being regarding what we speak (agreement, sympathy, objection, and so on). The same is true of listeners and their reply. Therefore, what is said is always done in a language that both unites and divides, a language that is a whirlwind of divergent and convergent forces, because it is heteroglossic (contextually and historically dependent, thus affording and conveying differences) and monoglossic (subjected at the same time to the centripetal and unifying effects of culture). According to Bakhtin, this embodied dialogue constitutes the very fabric of the horizon of meaning of human beings. The “other” provides, in this context, an additional and external (called exotopic) perspective necessary for the conceptualization of the self as a cohesive and meaningful whole (and vice versa). This dialogical interaction is crucial in the human intersubjective experience and in the formation of a properly ethical consciousness.

For our study, since learning means the formation and transformation of consciousness, understood as knowing with others, it seems appropriate for us to seek to account for the multiplicity of the reflections of the participating teachers and researchers, not only from their intentional relation to the object of research, but also in their dialogical interaction. It is important to understand that we are taking part, as researchers, in this dialogical interaction, joined in an equipollent way to the multiplicity of voices. This dialogical perspective overhangs the entire project and, in a way, cements our theoretical and methodological frameworks. Indeed, the dialogical perspective is articulated with our theoretical approach which gives importance to social interactions and ethics in mathematics education, while espousing the foundations of participatory research which favours the voice of the teachers to talk about practice.

Context of the study

More concretely, four secondary school mathematics teachers were recruited on a voluntary basis. Participants were mid-career teachers (12–25 years’ experience as secondary school mathematics teachers; two women, two men). A meeting was held to set goals and working arrangements and to schedule three additional meetings (150 minutes) during winter 2023 (February through April).

Data collection

Two researchers took part in the meetings, and two research assistants were present. The three meetings were video recorded. Videotapes of the collaborative meetings, transcription of the audio, and a research diary constituted the data. Transcripts were taken immediately after each meeting to allow for analysis during the collection and to initiate and guide the next meeting.

Data analysis

Our dialogical analysis assumed that all discourse, including inner discourse, is dialogically structured in that it always presupposes an addressee. The main question was therefore to know “from where” the different points of view arose (see Skinner et al., 2001). Specifically, each utterance was considered a “proposition,” the next one a “reaction,” and the next one a “reaction to a reaction” or “a conclusion” (Krzychała, 2019). Each utterance was then described, not only in its “literal meaning,” but from a “dialogical meaning,” i.e., how it appeared in the chain of utterances. To do this, we repeatedly indicated what was reflected from one utterance to the next. The result was that for each utterance, there was a reference to a theme, but also to other voices, those of the other participants, the researchers, and external entities. In essence, for each significant utterance, we indicated its “literal meaning,” the description of which was guided by 1) a thematic rubric (social or political issue, pedagogical or didactic reflection, orientation of co-production, or experienced or apprehended constraint) and 2) a mode of activity (goal, action, or operation). Then, for each utterance, we indicated its “dialogical meaning,” described from 1) its situation (proposal, reaction, conclusion) and 2) its evaluative orientation (agreement, sympathy, objection).

To gather and make sense of the analysis results overall, a “dialogical narrative” (Guillemette, 2017, 2021) will be produced. These short texts will make it possible to present and contrast the participants’ (including researchers’) various postures, while preserving and promoting their dialogical character.

Preliminary results

Let’s mention that, as it is a research-based presentation, we will focus here more on some research results rather than (positive) research outcomes - in terms of teachers’ professional development for instance. Based on the research diary developed through three meetings with the group and the preliminary analysis of their transcripts, we introduce in this section some preliminary research results.

To be coherent with our dialogical perspective, no specific theme or topic of discussion was imposed upon the participants. Rather, we introduced the project while remaining very broad when describing what a social or a political issues in mathematics education may constitute. In application, the participants were encouraged to share experiences and material through which tensions and dissatisfaction in their practice regarding these issues arose. Typically, they mentioned the difficulty of building learning activities where mathematics are not merely an analytic tool (for modelling, optimisation or representation), but a central way to explore authentically problems related to social and political issues.

The group (re)viewed two learning activities that were brought by two different participants. In the first activity, students were asked to choose whether to buy an electric or a gas vehicle, and in the

other activity, students needed to explore economic inequalities within OECD countries using different statistical tools (Lorenz's Curve and Gini coefficient) and statistics composite (such as HDI). These learning activities were lived as a kind of catalytic objet through which discussions and reflections emerged. Many themes have been addressed focusing on the social and political issues of mathematics education (such as curriculum prescriptions and programme options, assessment or the importance of mathematics in school success) and *in* mathematics education (such as the concrete development of the two learning activities for the classroom).

We present here a short excerpt of a dialogue on students' different programme options in Quebec (Canada) secondary school called paths, through which students are exposed to different kinds of mathematics (science option, technical and scientific option and cultural, social and technical option). This discussion emerged as the group wondered for which of those paths the activity on economic inequality was most appropriate.

- Anton: We will, I think, create certain profiles, certain "subjectivities" in mathematics, a relationship with mathematics that people will have, relationships with mathematics will be created which will be consolidated through a well-chosen path. [...] Why not offer, on the contrary, to everyone, the ideas, all the ideas and all the richness of mathematics? For instance, in the [Mathematics for Science program], we will have more formal, more deductive mathematics. We're going to work more on, let's say, mathematics as a formal science [...], but that's important for everyone in society.
- Nastassia: The interest is not always there for formal mathematics, that's it.
- Anton: Same for the applied or cultural program, in the sense, I don't want to devalue it.
- Nastassia: But, for me, the richness is having different knowledge, complementing each other and discussing each other, and not necessarily everyone follows the same process to the end. Richness is being different.
- Anton: Yes, but we're all gonna be different in the end.
- Nastassia: You don't have to have the same expectations for everyone.
- Daria: It's true in French, they are all mixed up. There is no enriched French. [...] But mathematics should be inclusive. I find that a shame, it's political, you have to accept that it is a political question, I find it a pity that it will depend on the person who is in front. Because differentiating is an art. But it will depend on the person who will orchestrate. That year, [a student] will come across a teacher who will differentiate, who will give feedback ... they will experience success...

In the excerpt (translated from French) we can see how Anton's, Nastassia's and Daria's voices interacted around the students' different paths. Different voices are in tension, those of the participants (including the researchers), but also the voice of the government that inserts itself in the speeches through the curriculum prescriptions and orientations. These tensions relate to the deterministic role those paths have on the students in mathematics. More precisely, tensions emerged around the need, on one side, to acknowledge the interest, the diversity and the particularisms of the students in mathematics and, on the other side, to initiate all students to different kinds of mathematics and way of being and doing in mathematics, in search for open, reflexive and ethical subjects in mathematics.

Conclusion

In this paper, we introduced an ongoing study that seeks to document the epistemological, didactic, and pedagogical reflections of secondary school teachers related to social and political issues in

mathematics education, the emerging ways to implement teaching activities along these lines, and the difficulties encountered. We highlighted the need for participatory research in the field. We developed a dialogical approach in our methodology that allowed us to articulate our theoretical framework with the epistemological foundations of collaborative research and to include ourselves as researchers in the description. More in-depth analyses and research results are to follow.

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