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REVIEW

Essential tensions of mathematics in education

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Abstract: The didactics of mathematics deals with the conditions of transmission of mathematical knowledge; various dimensions related to the production of knowledge in the classroom constitute its object of study. From the perspective in which we place ourselves, mathematical concepts are characterized in terms of some nodal problems whose resolution by subjects to whom certain knowledge and knowledges are attributed. In recent years, the curiosity to know the student's perception of mathematics has been growing. This link between knowledge and mathematical problems, far from being static, implies conceiving the teacher as the conductor of a path in which the initially elaborated relationships are validated, transformed, decontextualized, generalized and reorganized into more inclusive constructions than those originally considered. In this sense, the present study aimed at analyzing the tensions of mathematics in education. The results indicate that students present tensions under a hydisyncratic perception.

Keywords: Education, Knowledge, mathematic, tensions

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1. Introduction

The definition of tension can take different forms depending on the context. In the framework of this research, we have established the following definition of tension: A feeling of imbalance or discomfort, resulting from the contrast between the experiences in the professional development workshop and what configures the teacher as such: his or her beliefs, expectations, reflections, experience, perceptions from a teacher's point of view [1–3]. These aspects range from the methodologies used in the classroom to the teacher's expectations of his or her students. Other authors have defined tension according to their context. They define tension as the conflicts that can arise when mathematics teachers encounter

a disparity between what they want to do and what they are asked to do, or between what they want to do and what they know how to do [4–6].

Researchers in didactics of mathematics and teachers of this discipline constitute different communities. Indeed, their social responsibilities are different, as are their institutional affiliations, the constraints of their work, and the expectations that are placed on each of these groups at different levels of society. However, all of them struggle with the teaching of mathematics: for all of them it is a source of questions, uncertainties, challenges [1,3,7]. What are the relationships between these two "worlds"? Obviously, the answer is far from being unique, but those who, from the field of mathematics didactics,1 have more systematically investigated this question, concerned about the lack of dialogue between researchers and teachers, have carried out a critical review of their own positions, which has contributed to conceive modes of exchange organized from the common purpose of contributing to the improvement of teaching [1,8,9]. It is important to know the role of mathematics in all activities and project execution [10–18].

The notion of tension is intended to capture the feelings of internal doubts that many initial teachers' educators experience in their teaching of teaching, when they find themselves pulled in different directions, by competency concerns and the trainers' difficulties in learning to recognize and manage these opposing forces. Our definition and Berry's agree that tensions are experienced when there are competing aspects, but differ in that the contrasting aspects are, in Berry's definition, different experiences during the initial teacher educator's practice and in our case, the teacher's experience during the TDP and its projection to the classroom [2,3,19].

The didactics of mathematics deals with the conditions of transmission of mathematical knowledge; various dimensions related to the production of knowledge in the classroom constitute its object of study [1,2,20]. From the perspective in which we place ourselves, mathematical concepts are characterized in terms of some nodal problems whose resolution by subjects to whom certain knowledge and knowledges are attributed – it is hypothesized and is the object of inquiry – makes it possible to elaborate fundamental constitutive relations of these concepts. This link between knowledge and mathematical problems, far from being static, implies conceiving the teacher as the conductor of a path in which the initially elaborated relations are validated, transformed, decontextualized, generalized and reorganized in more inclusive constructions than those originally considered [1,2].

These theoretical contributions to the state of the art challenge teachers and experts in didactics to develop mathematics teaching based on principles such as activity, to learn by doing and participating, creativity, stimulating thinking and research, interdisciplinarity, connecting mathematics with other areas of the curriculum and cross-cutting objectives, and socialization, connecting mathematics with cultural reality and developing it through collaborative work [5,21–23].Thus, the objective of this study was to analyze the trends and challenges in mathematics teacher education and to establish their challenges. In this sense, the objective of the present study was to analyze the essential tensions of mathematics in education [3,8,24].

2. Some tensions identified

These tensions, identified within society, the school and the curriculum, arise as a result of the neoliberal model that seems to be guiding, also, the educational processes in the country. It is necessary, then, to understand this model as a background cloth in education, in order to understand how the curriculum and some aspects inherent to it are transformed, for example, science, knowledge, pedagogical practice, power immersed in the school, among others. Under the neoliberal model, and its supporters, the educational crisis is centered on three aspects [3,24–26]: the welfare State and its interventionism; the unions and organizations that allow maintaining past inertias; and

the ideology of social rights, which hinders the construction of new policies to overcome this crisis, according to thismodel, it is not up to the State to administer or directly provide the service, but only to ensure broad coverage and its quality. To this end, a decalogue of administrative and financial policies has been imposed to rearticulate the social existence of education, namely: decrease in spending per student; increase in the number of students per classroom; transfer of education to local governments; transfer of the management of centers to other private groups, to non-governmental organizations (NGOs), etc. The following are some of the main elements of this approach [24,27]: decrease in spending per pupil; increase in the number of pupils per classroom; transfer of school management to other private groups, NGOs, etc.; subsidy to private schools; reduction in teacher salaries; increase in class hours; targeting the poorest of the poor; control of accounts and management by local communities; capitation, that is, allocation of resources per student served [5,21,28,29].

Thus, neoliberalism intervenes in education, as a public policy, generating a decentralization of management and financing. In this way, the educational crisis became a matter of efficiency, seeking to optimize the allocation of resources and spending. To guarantee such optimization, says Mejía (2001), the centralization of pedagogical control is maintained, through national evaluation projects and curricular contents that guarantee the world trends of insertion in globalization, and through criteria for teacher training. The phenomenon of globalization expresses the fusion between neoliberalism and neoconservatism: the "neo-neo" model [3,30]. The former emphasizes the economic freedom of the market economy as a prerequisite for political freedom, and the latter, through its concern for maintaining social order, proposes severe limitations to the democratization of society. The "neo-neo" model brings with it an education for the market, fostering, among other processes, those derived from: exclusion; discrimination (racism, xenophobia, sexism, classism); disrespect for multiculturalism; homogenization (through external regulations, translated into evaluations of the student, the teacher and the institution); displacement; dual relations between minorities and majorities, and a dichotomous relationship between training and information. With the intervention of the neoliberal model in education - where there is, on the one hand, the decentralization of management and financing, and on the other, a centralization of pedagogical control - several tensions within the curriculum are emerging [3,31–33].

One of these tensions is produced by the desire to maintain, on the one hand, homogenization in schools and, on the other, to respect the social and cultural diversity of students. In an attempt to overcome this tension, different academic discussions and movements have been generated. For example, the debate on the relationship between everyday knowledge, derived from social practices, and school knowledge, derived from conventional academic practices [2,20,24]. In other words, the dichotomy between knowledge considered non-academic and that validated as academic is made explicit. In this sense, two tendencies have been identified in a possible curricular organization: first, school knowledge 'recognized and legitimized by academia' is superimposed on everyday knowledge 'recognized and legitimized from and by social practices'. In these power relations established between these two forms of knowledge, the curricular structures, in addition to legitimizing only school knowledge, prevent the inclusion of everyday knowledge that is constructed outside the school and in dialectic with social practices. Secondly, curricular structures, through external evaluations, exercise power and control over school institutions, teachers and students. This tension

This tension highlights some issues related to processes of exclusion, issues that constantly permeate daily school life. In this sense, when school knowledge ignores or delegitimizes other forms of knowledge and knowledges, a form of social exclusion is generated, since this leads to the delegitimization of the social practices that support such knowledge.

3. Challenges

Despite the dominance of this neo-liberal model in education, I continue (we continue) to believe in education as a concrete social practice, in an education conceived as a practical activity -not technical- in the sense assumed by Aristotle: an activity that seeks to justify its value in what it does, and not just in what it obtains as a result. Here it is good to stop and think about the reality that I observe in Colombia, a consequence of the "neo-neo" model mentioned above. This reality, indistinctly, speaks to us of hunger, misery, violence, war, destruction, displaced people, indigenous and afro-descendant communities fighting for the survival x survival of their cultures. This reality also speaks to us of technical development, of the incorporation of new technologies in school curricula, of the information society, etc. And, in this reflection, we should also think about utopia. Utopia as that dream that triggers, in everyone, the need to build, overcoming the distance between the real and the ideal. So, then, it is worth asking: what are our utopias, as mathematics educators, in the face of this reality? What are our utopias, as teachers who teach mathematics, in the face of this reality? On the one hand, there is the education in which I believe, and on the other, the education that is the product of the "neo-neo" model. It would seem, then, that education and we, teachers and researchers, are going through a moment of crisis. This moment of crisis makes the real-life teacher increase the constant dilemmas, anguish, disappointments and sufferings that are part of his daily pedagogical work, makes teachers live in constant tensions. New questions then arise: what are the possible futures to face this moment of crisis?

In a sociocultural perspective of education, knowledge is no longer seen as an external product to be appropriated by individuals, transgressing the paradigm of modernity, but as an interpretation that subjects make of the world, in a continuous dialectic with their social, cultural, historical and political environment. That is to say, knowledge is produced by the subject in his interrelations with the world. Under this sociocultural perspective, mathematics education assumes mathematical knowledge as a social activity, whose production and legitimization is the result of the explanation of different social practices in which the subjects are involved, based on shared senses and meanings, thus respecting the different knowledge constituted by the different sociocultural groups within them.

4. Conclusions

Each educational instance has aspects that make it unique and therefore the subjects of study in the model will have to be changed or the model will have to be extended or simply discarded. Approaching mathematics education from a sociocultural perspective, when it comes to researching it and preparing teaching activities, is not easy. There are different tensions, generated by the dichotomy that researchers and teachers face. Such dichotomies are the result of the immersion of the neoliberal model in educational processes, or if you will, of the "neo-neo" model, where we must attend, on the one hand, to the cultural diversity of the students, but, on the other hand, to the homogenizing processes internal and external to the school institutions.

Advancing in the conceptualization of collaborative work between researchers and teachers was one of the objectives set for this project. We had anticipated from the beginning of our work that collaboration would be a long-term process. The analysis of the path has allowed us to better understand the complexity involved and the tensions to which it is subject.

Deepening the understanding of conditions favorable to the constitution of collaboration was an object of this project. This construction is at the heart of some tensions that cross it: training and the

naturalization of practices and positions permanently "resist" the emergence of genuinely collaborative exchanges. Having had to face in a shared way issues that required elaboration in the field and excluded the possibility of prefabricated answers – this was the case, for example, as a result of the need to interpret the students' procedures in the meetings – contributed to the installation of new questions – what do we do with this that the children did – that transformed the initial game of demands and answers, typical of the training situation, into exchanges where exploration became more and more important.

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