

Teachers epistemology on the origin of mathematical knowledge

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Abstract: *This research sought to understand the origin attributed by teachers to mathematical knowledge. The theoretical framework guiding this research is the Socioepistemological theory of Educational Mathematics which accepts mathematics as a human activity that is resignified and reconstructed in specific contexts. This qualitative research forms a heuristic case and uses Grounded Theory as an information processing technique. The results showed most teachers understand mathematics as a priori knowledge, assigning to human action the role of discovering, interpreting or formalizing it.*

INTRODUCTION

The problem that rises this research shows that throughout history, a logical-rational epistemic stance of idealistic legacy has prevailed that finding its most developed expression in the twentieth century in the Vienna circle (Natkin and Radakovic, 2002). The mono-epistemic tendency where mathematical knowledge has mostly been understood can be related to a platonic influence of reality, where idealism of objects predominates over real material situations. This way of understanding reality and knowledge isn't casual, it implies the struggle of antagonistic ideological trends that defend historical interests and directly affect our ways of life. Therefore, idealism obtains its objectivity mark regarding its object of true knowledge requires being stable, permanent and immutable. Objects must have clear and scientific definitions. This apriorist conception of reality affects mathematical knowledge and understands it as a type of knowledge populated by static, immutable and ideal objects. From the intuitive contemplation of Plato's ideas, Leibniz's monadology for innate ideas resolution, the intuition and concept as foundational elements of knowledge in Kant, the idea of the absolute self in Schelling, to the dichotomy between thinking and knowing of Hegel, there is a relegation of man from the creative and transformative possibility of his own history as soon as he creates and defines the concept in the context of a material reality, then he knows.

It is interesting to know the origin that teachers attribute to the knowledge they teach, because the role of school in the construction of a type of human being is not only determined by different curricula, which tended to social reproduction of our class societies (Bourdieu, 1997), but also teachers and their teaching action, which could determine what kind of individual the school will generate and therefore the type of society we will have.

For these reasons, the objective of this research was to know the origin attributed by teachers to mathematical knowledge. One significance of the research is the visibility of the few moments that teachers have to reflect and problematize the discipline they teach.

THEORETICAL FRAMEWORK

This research is carried out from the Socioepistemological Theory of Educational Mathematics. The theory understands mathematics as a human activity made by individuals or social groups in specific contexts. Socioepistemological theory adopts the principle of epistemic relativism and contextualized rationality. Socioepistemology creates its theory from the study of reality and accepts a human who builds and understands his knowledge in a social and cultural context through interaction, denial and dialogue. From here, mathematics is conceived as a knowledge with its own meanings, constructed and reconstructed in the context of the human activity. The theory is relativistic, it doesn't assume forms of specific knowledge as absolute, but creates meanings from the use that the user makes of mathematical knowledge (Cantoral, 2013). This approach allows us to try to understand how teachers understands the origin of mathematical knowledge, from apriorism or from laterism.

METHOD

The research used the qualitative method based on the Grounded Theory (Strauss and Corbín, 2002). A line-by-line microanalysis was started to perform the open, axial and selective coding processes. A heuristic case of 75 math teachers from La Araucanía region in Chile was studied. The heuristic case that we build according to Eckstein (1975, in Tarrés 2008), corresponds to a deliberate choice that is made in order to contribute to the theoretical development of an idea. These teachers work in schools and high schools in the region with students from 6 to 16 years old. The information was collected in moments of pedagogical reflection that were carried out individually with each of them. Dialectics was used as a strategy for analyzing information in order to answer the origin that teachers give to mathematical knowledge. Once the analysis categories

were created, they were contrasted with the theoretical revision of the nature of mathematical knowledge.

RESULTS

The results of the study show that 50 of the 75 professors understand mathematics as a priori knowledge. They mention that they are discovered by man through observation. They claim that they have their origin in nature and constitute a universal language. The action of man lies in formalizing a discovered knowledge. Another 20 participating teachers declare that mathematics is human creation used to know the natural world and quantify it. Four teachers declare not knowing what to say because they have never thought about it.

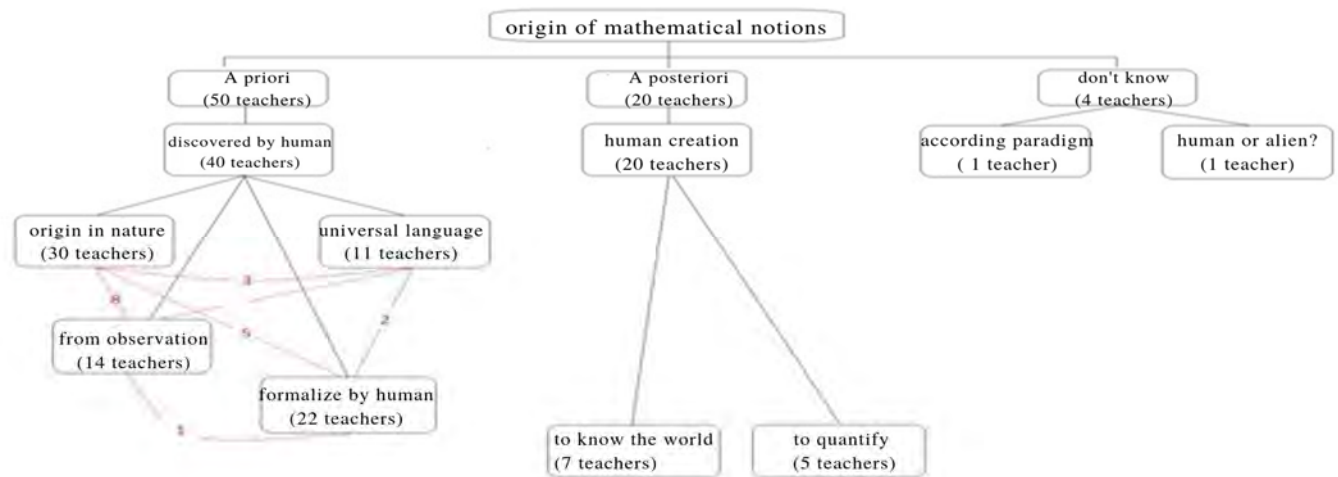


Figure 1: Origin of mathematical notions according to teachers

By contrasting the information collected from the teachers with the theoretical revision made for this study, we were able to identify the relationship between the statements collected and some classical positions of how the origin and nature of mathematical knowledge in history has been understood.

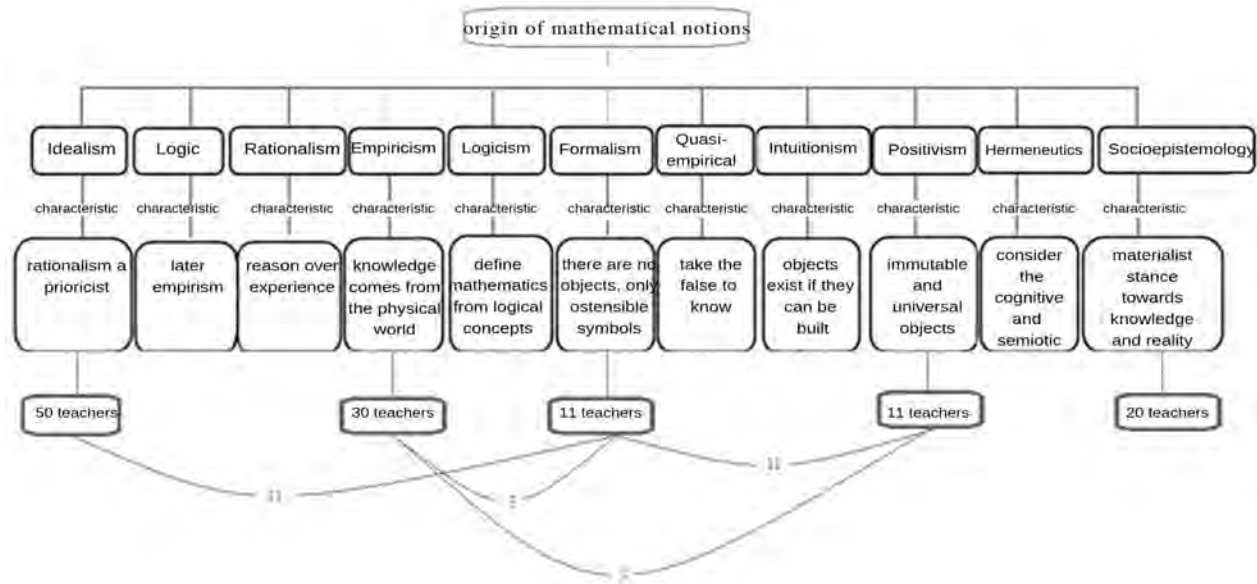


Figure 2: Relationship between teacher statements and classical positions in history

CONCLUSIONS

Understanding mathematics as a priori knowledge is a position that predominates among participating teachers. This view has dominated the epistemology of knowledge throughout history under the influence of Eurocentrism. The denial of the creative possibility of human over his reality is also the denial of the possibility of modifying it. This way of thinking is interesting to observe in teachers whose role is not only to teach mathematics, but also to create a type of human being from the anthropogenic function of the school. A small group of teachers shows a posteriori stance of knowledge, but they are not able to show grounded arguments about their sayings. Those are more intuitive and 4 of them express they don't know and haven't thought about it until now. On the latter, the teacher's lack of reflection on the discipline they teach is observed and the need to look at the destination of the teacher's time in the school in order to provide spaces for reflection and dialogue. The concern to observe the processes of teacher training exist and the importance that these processes attribute to the problematization of the knowledge being studied. There is no doubt that the institutions training teachers are responsible for teaching disciplinary, didactic and pedagogical knowledge issues, however there is no certainty of the importance they attach to the study of the epistemology of knowledge. As a result, a group of teachers with difficulties to discern epistemologically about the knowledge they teach is observed. The research shows teachers who

are not able to establish their position with certainty against the origin of mathematical notions, their statements are rather influenced by cultural constructions or the phenomenon of colonization. As a result, it is difficult to move forward from a group of teachers who knows how to operate mathematically by applying theorems and algorithms to achieve a group of them questioning, problematizing and understanding the nature of the knowledge they teach.

The effects of aprioricist epistemological positions threaten the assessment of the social construction of knowledge. From analyzing the epistemology shown by these teachers, it is observed that they do not refer to reality as a social construction, nor to knowledge. We cannot say with certainty if the epistemological positions that teachers demonstrate would remain stable if they became aware of them and knew the historical development of epistemological currents and their relationship with the scenarios where they have been formed. Something that is clear is that teachers speak from intuition or conviction without argument, which suggests some possible shortcomings in teacher training processes.

The a priori positions of the teaching staff can be a difficulty to achieve the learning of their students, especially those who are in the stage of concretism. When what you are trying to learn is presented as alien, different from our material and historical nature and becomes achievable only through intuitive processes or not always simple logical reasoning, then a barrier difficult to overcome is formed. In these cases, the ability to know how to move in the Platonic world is required to acquire intuitive knowledge of its objects or conceptually discriminate the axiomatic properties of abstract notions.

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