

Mathematical Subjectivations and the emergence of the subject in Mathematics Education: a historical-cultural perspective¹

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RESUMO

O presente artigo busca contribuir teoricamente para a Teoria da Subjetividade a partir da Educação Matemática, ao mesmo tempo, que desenvolve a partir da Teoria da Subjetividade (TS) uma compreensão teórica das subjetivações matemáticas. Toma como referencial para as discussões as teorias da TS e a filosofia de Lukács. Como resultados encontrados estão as categorias de campo de significâncias e a sua constituição como uma lógica dialético-configuracional e o esmiuçamento das configurações subjetivas da ação de aprender matemática, da ação de matematizar, do diálogo e da criatividade-rigor. Por fim, constituiu-se um referencial heurístico poderoso para investigar os processos subjetivos em Educação Matemática tendo como patamar a interrelação objetivo-subjetiva do Ser Social.

Palavras-chave: Teoria da Subjetividade. Educação Matemática. Subjetivações. Lukács.

ABSTRACT

This article seeks to contribute theoretically to the Theory of Subjectivity from Mathematics Education, at the same time which develops, from the Theory of Subjectivity (TS), a theoretical understanding of mathematical subjectivities. It takes as a reference for discussions the theories of TS and the philosophy of Lukács. The results found are the field categories of significance and their constitution as a dialectical-configurational logic and the breakdown of the subjective configurations of the action of learning mathematics, the action of mathematizing, dialogue and creativity-rigor. Finally, a powerful heuristic framework was established to investigate subjective processes in Mathematics Education, taking as a level the objective-subjective interrelationship of the Social Being.

Keywords: Theory of Subjectivity. Mathematics Education. Subjectivations. Lukacs.

1 Situating the research problem

The Theory of Subjectivity (ST) brings a set of qualitative changes in the fields of education, professional practice and research, and constitutes a theoretical

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field that reorganizes the way we think about and investigate problems related to the formation of human subjectivity. However, without this being a 'lack' or flaw, we perceive a certain incongruity in two aspects that directly implicate our research problem.

The first refers to how scientific fields and their symbolic processes impact the formation of subjectivity and subjective configurations. In summary, we perceive a dubious explanation about how social institutions, objectivities, are constituted in social subjectivities, generating diverse subjective senses and configuring themselves in them. Among these social objectivities, or social complexes (LUKÁCS, 2013), are Mathematics Education, science in general and ideologies.

We pay specific attention to how the learning of Mathematics contributes to the formation of human subjectivity. As a cultural symbolic field, Mathematics impacts the generation of subjective senses, however, the specificity of scientific disciplines is not worked on by the authors of ST. Learning is precisely an action, a symbolic-emotional process of the action of learning that generates subjective senses that converge and are organized in subjective configurations. The subjective configuration of the action of learning is the subjective senses generated in this action implied by the personality, where the learner does so as a "system and not only as an intellect" (GONZALEZ REY, 2006, p. 33). In this configuration, subjective senses of the learner's life history are generated, linked to their experiences in the most diverse social spaces that they transit through and their social subjectivities (family, groups of friends, street games, church, race, gender, etc.), and linked to the course of the learning action itself.

In this action of learning, the subjective senses define the quality and type of learning that will occur, and, in the course of this action, the most stable subjective configurations of the personality have a direct impact on the generation of these subjective senses. From this point of view, there is a denial of cognitivist views of learning in which what matters is the work with information and the way the student reacts to it, while in these perspectives emotions and affections are understood as catalysts of cognitive learning processes. In the generation of subjective senses, emotions are represented by symbolic processes, and these are

constituted by emotionality. Affections are not external to the cognitive, primarily because from this perspective it makes no sense to talk about it. The conception of cognitive is linked to a quality of the psyche that is shared in different dimensions between humans and other higher animals and refers to the ability of reacting to external adversities, closely linked to a mechanized process of the psyche. Evidently, the human psyche is developed in reference to other animals, but it is precisely because of the ontological emergence of subjectivity in the Social Being that reacts to it, transforming it qualitatively.

The main question is not about whether the symbolic processes of Mathematics are endowed with emotionality. What concerns us is the understanding of a certain type of equilibrium in the conceptions of the authors of the ST. There are many implications of this paradigm shift from learning to a symbolic-emotional unit in the context of Mathematics Education. However, it seems to us that for these authors there are no ways to differentiate mathematics learning from Portuguese learning since they are equally stable.

That is, if there is not much to say about these specificities, then does it not matter what symbolic processes the subjective configuration of the action of learning focuses on? Evidently it is a rhetorical question that everyone would immediately answer that, yes, it matters. We call attention to the fact that it is not understandable from this perspective how these matters. More specifically, Rossato (2009) speaks of a circuit in dynamic equilibrium in the processes of subjective changes, that is, subjective development becomes a process that points to equilibrium. Particularly, we understand the opposite, and we intend to expose it below. The process of subjective development is a process that does not come into equilibrium, it is precisely given in difference and contradiction, and its contradictions do not close a stable circuit.

In this aspect, we call this process of subjective development a dialectical-configurational logic of subjectivity, and we intend to explain how mathematical symbolic processes impact the generation of subjective senses from the fields of significance.

2 The dialectical-configurational logic of the fields of significance

As we have previously explained, neither the dialectical-configurational logic nor the fields of significance are part of the theoretical productions of ST that investigate the subjective dimension of the human being and culture. We understand these two subjective complexes as participants in the processes of subjective development, which take place in difference and emerge from the learning of Mathematics, a symbolic system of culture. The fields of significance and their dialectical-configurational logic seek to interpret how an objective symbolic system of culture is subjectively configured, generating subjective senses in a social subjectivity.

The subjective senses and their subjective organization are fundamental units in this understanding. They are singularizations of social objectivity, while the latter, structurally stable, becomes its universal³. On the other hand, of all subjective production converted into social objectivity in symbolic productions in culture, its subjective resources are externalized in such a way that each objectification is a singularization of the subjectivity which objectified it, this subjectivity being its universal. That is, the singular-universal dialectic is not static, but a contradictory and tense process and movement that is modified throughout the social complex in which it operates.

The problem lies in how structured, stable and more generalizable social objectivity is converted into unstable complex units, which follow non-linear flows and with combinations that are impossible to generalize? On the other hand, how is a subjective organization, specifically subjectivity, which is a symbolic-emotional system that responds to a complex and unstable configurational logic, capable of objectifying stable and structured symbolic systems?

As Lukács (1978) explains, in the "transitions" of universal and singular, and from singular to universal, there is always an extensive field of mediations, called the particular, which allows the transit of the Social Being between the singular-universal dimensions. More precisely, we invoke the particular to

³ The universal in Gonzalez Rey does not take place in the Marxist perspective, which is why he is a staunch opponent of this terminology. The universal in this work is always linked to the complex dialectical process between singular-particular-universal developed by Lukács.

constitute the social complex of the **fields of significance**, this being the field of mediations of the social particularity that answers the question pointed out in the previous paragraph. Because it is a field of mediations, it is extensively and intensively complex, and precisely in our study we will work on it solely and exclusively from the perspective of the social complex of Mathematics Education.

In Marxist dialectics, unlike Hegelian dialectics, contradiction in its moments always assumes some preponderance. That is, the moments of contradictions and tensions form a complex unity, however, depending on the context in which they act, one of these moments assumes predominance over another, depriving the dialectical balance. In Hegel, this dialectical equilibrium was maintained as the Absolute Spirit, but for Marx, dialectics does not constitute equilibrium, but disequilibrium, which is where the concept of predominant moment emerges (LUKÁCS, 2012). In work, the predominant moment is the pre-ideation, as it chooses between alternatives, guides and regulates the entire teleological process. However, the latter does not determine the setting of the end, that is, it is not the cause of the final objectification and, therefore, the understanding of a predominant moment in dialectical relations does not imply defining one as the cause of the other. At work the ideal moment implies the real moment, and vice versa, without either being the cause of the other. In this sense, when analyzing a complex unit acting in a determined social complex, it is necessary to investigate its predominant moment.

In this context, we speak of dialectical-configurational logic. Configurational since its functioning is unstable, unstructured, recursive and iterative, and dialectical at certain moments it predominates over others in the procedural course of a social complex. Gonzalez Rey (1997) understands that dialectical logic is incorporated into configurational logic, and makes this analysis based on the epistemology of complexity. The consistent fact is that the dialectical logic embodied by the epistemology of complexity, and present in configurational logic, is the Hegelian dialectic, as we analyzed earlier about the constitution of dynamic equilibria. Here, when we express a dialectical-configurational logic, we are incorporating Marx's singular-particular-universal dialectic.

Having explained where the incorporation and critical foundation of a dialectical-configurational logic comes from, it is necessary to explain the sources of the theoretical constitution of the field of significance. The fields of significance have two main inspirations, one from Gonzalez Rey (1997; 2006) and his reflection on the zones of sense and the production of intelligibility about the social world, and another from Vigotski himself (2020) in the discussion about the sense and meaning of the word in the formation of thought and language.

For Gonzalez Rey, the zones of direction are

spaces of intelligibility that are produced in scientific research and that do not exhaust the question they signify, but, on the contrary, open the possibility of continuing to deepen a field of theoretical construction. The concept of "zone of sense" has, therefore, a profound epistemological significance, insofar as it confers value on knowledge not for its linear and immediate correspondence with the "real", but for its ability to generate fields of intelligibility that allow new zones of action on reality, as well as new paths of transit within it through our theoretical representations. Knowledge is legitimized in its continuity, in the ability to generate new areas of intelligibility about what has been studied and to articulate these areas in increasingly complex models, oriented towards the production of new knowledge. (2006, p. 24, our translation)

The concept of zones of sense in Gonzalez Rey has a profoundly epistemological character in which he is concerned with producing scientific knowledge throughout the study of subjectivity. More specifically, the sciences act as zones of sense to constitute symbolic systems about reality, and in the constitution of these zones that are not linear correspondences with the "real", imagination and creativity are fundamental. That is, it is through the constitution of zones of sense that the social complexes of science compose the subjective dimension of scientific knowledge. These zones are not mirrors and refractions of reality, but creations generated by subjective senses.

In Gonzalez Rey, the zones of sense are taken as epistemological constructions, that is, as fields of intelligibility that do not constitute the ontological status of subjectivity itself, and that is a primordial issue. In this sense, the fields of significance are constituents of the ontological status of the Social Being. It is not through them that science produces knowledge about reality, but they are primarily constituents of it. The change of term and status from the zones of sense in Gonzalez Rey to fields of significance, in this work, takes place through

the analysis of the meaning of the word carried out by Vigotski. According to the Soviet author, meaning predominates, and as sense is the dynamic, fluid and complex formation, it has within it several zones of stability in which "meaning is one of those zones of sense [...] more stable, uniform and accurate" (VIGOTSKI, 2020, p. 465).

Meaning is understood as a brick in the complex process of construction of sense, more specifically, it is a symbolic process of culture. We take this understanding as a stable zone of sense to constitute the fields of significance. If in Vygotsky the meanings are configured in a purely symbolic process, in our understanding they do not conform individually. Meaning in Vygotsky is always the meaning of the word, and thus always a dynamic though stable symbolic process. However, meanings are not necessarily articulated solely with the word, they escape from it and are still reproduced. Every meaning is a field of significance generated by subjective senses. The difference is that these fields of significance are configured in such a way that the senses that generate and are generated are endowed with predominant moments: the symbolic processes.

The fields of significance are subjective configurations that are organized in the process of cultural production of reality linked to subjective objectification, that is, to symbolic productions about reality. The subjective senses generated by these fields are predominant in their symbolic processes, since they are directed to the objectification of their subjective dimension. All objectification is a symbolic-emotional process, but predominantly symbolic. The subjective senses continue to be the complex ontological unit of the fields of significance, however they assume a more specific quality since they constitute a particular subjective configuration of the Social Being, the one responsible for the symbolic-emotional transitions between the objective and subjective dimensions. This specific quality is the predominance of the symbolic as a moment of subjective senses. And here it is important to emphasize, the predominance of a moment does not imply causality, much less an externality relationship.

The Theory of Subjectivity foresees the organization of dominant subjective configurations throughout the course of actions and personality, and understands them ontologically as constituents of subjectivity, but does not understand the

same for the complex units that are the subjective senses. And this is not a mistake.

The predominance of the symbolic moment in the subjective senses is a specificity of the fields of significance. The subjective configurations of the personality are more stable and the life history experienced by the individuals in all the other social spaces experienced are implied in the course of action, while the subjective configuration of the action refers to the organization that the subjective senses conform throughout it, that is, every process of subjectivation is constituted in the action. However, throughout every human action there is an objectification, which can be material or immaterial, which externalizes subjective resources and produces the symbolic systems of culture. In other words, in the analysis of subjectivations, the subjective configurations that make up the personality and those that are configured in the course of action are sufficient. However, when we analyze human activity in its complex unity of objective-subjective processes, a third subjective organization emerges referring to the subjective configurations of the fields of significance, with a predominance of symbolic moments in their generated subjective senses.

It is through the mediation of these fields of significance that the individual and social subjective configurations generated in social spaces are constituted into symbolic systems and over time can be converted into normative spaces, institutions, moral codes, sciences, ideologies, etc. The subjective dimension of Mathematics Education is conceived around a field of significance formed by three dominant subjective configurations: the action of learning, mathematization and dialogicity. However, to affirm that this subjective dimension is organized as a field of significance does not mean to reduce its subjective organization to these fields. In the case of Mathematics Education, as we will analyze in the following paragraphs, other subjective configurations conform to and influence the generation of subjective senses that do not have the symbolic processes as predominant: subjective configurations of the paradigm of truth-error, creativity-rigor and instruction, in addition to all the subjective configurations that match the personality of the subjects. In other words, the subjective organization of Mathematics Education is complex and dynamic, where in certain contexts it forms

fields of significance, without being reduced to them, while others are subjectively configured in a different way.

The subjective configuration of the action of learning is that conformed in the course of the action of mathematical learning. In this one, the world of the classroom or other contexts in which it occurs is experienced and the system of subjective configurations of the personality of all those involved is implied. In *a broad sense*, the subjective configuration of the action of learning and the subjective senses self-generated by it do not specifically express a predominant quality of the symbolic processes, that is, the subjective senses generated in the course of the action of learning may be predominantly symbolic, although in the general course of the latter they are not. In *the strict* sense, the subjective configuration of the action of learning Mathematics conforms to a dynamic flow of subjective senses in which symbolic processes predominate in their complex units. This allows, as we have previously analyzed, a field of particular mediations for the constitution of symbolic systems about reality, while at the other pole of this complex unity it allows the consolidation of a conceptual thought.

The specific focus of these subjective senses generated and generating the field of significance in the course of mathematical learning is the conformation of a symbolic system about reality in the subjectivity of the learner, which in Vygotsky (2020) appears as a conception of conceptual thought. Thought in Vygotsky (2020) is still marked by a strongly cognitivist conception, despite the fact that throughout the work itself it generates, in its last chapter, a complex conception of thought no longer tied to the cognitive. Thought is a field of significance in which a creative and symbolic character of the subjective senses generated prevails.

The subjective dimension of learning is subjectively configured in the course of action with the implication of personality. However, as every action occurs in a social space conformed to social subjectivity, it is impossible to speak of learning as an individual process. The subjective dimension of mathematical learning is the generation of subjective senses, predominant in its symbolic processes, without these ceasing to be implicated in systems of subjective configurations that do not constitute a field of signification. That is, in the course

of the action of learning, the symbolic system about reality established by Mathematics is included, which is articulated as a field of significance. However, in the course of every mathematical learning action, the subjective configurations of personality and social subjectivity in which the action occurs are implied, and these do not necessarily conform to fields of significance. In summary, mathematical learning occurs at two subjective levels, one marked by the fields of significance and the other usual, without, however, being able to separate them since they form a flow of subjective senses that is constant, conflicting, tense and concomitant with each other.

In addition, in any action whatsoever, individuals and social groups learn, there is no action without learning. Therefore, in any Mathematics class there is learning of something, which may well have no relation to the symbolic-cultural system of Mathematics, but there is still learning. The learning of Mathematics that seeks to be measured in tests and exams does not correspond to the formation of a field of significance, because the resolution of a test can occur successfully without the student having conformed this field and thus constituted a symbolic-cultural system about reality. This analysis appears in Vygotsky (2020) when he explains that there are thought complexes that perfectly imitate conceptual thinking, such as thinking by complexes and with pseudo-concepts. That is, D'Ambrósio (2001) already taught us that tests say almost nothing about learning and create a deformation of pedagogical practice. At the end of the day, the tests are strange deformations of the ideology of certainty (WAGNER, 2022) and the right-wrong paradigm directly articulated with the system of grades and credit.

Therefore, the fields of significance, which here constitute parallels to Vygotsky's conceptual thought, are not capable of being evaluated and measured by traditional tests and exams. More than that, a student can achieve a positive result in these tests without having conformed to a field of significance with which he can actively act in the culture⁴, while he may have conformed a field of significance and achieve results considered poor.

⁴ Common practice among students is to study the day before the test, memorizing the content, and being able to answer correctly the next day. After the test, they remember nothing, precisely because they did not conform fields of significance. The fields of significance take this phenomenon

In this reflection, to a certain extent inspired by Vygotsky's considerations on conceptual thought, we seek to make explicit the impacts of the fields of significance on the symbolic-cultural action of the subjects who learn, that is, on their social objectifications. Symbolic-cultural action is the process of social objectification of individuals and social groups, and such objectifications are incapable of being defined as mathematical, physical, philosophical, sociological, etc., since they are an objective synthesis of the symbolic-cultural systems of these subjects and an externalized expression of their subjective dimensions. In the end, the cultural objectification of these symbolic-emotional systems does not necessarily need Mathematics as a scientific discipline organized in schools today, but does not dispense with the complex of *Matema* – Being of Mathematics Education.

The fields of significance actively reconfigure the system of subjectivity in **leaps and bounds**, primarily because they open up to the subjects a field of cultural practices that did not previously exist. That is, the fields of significance can lead to an integral human development since they expand human capacities for development, while estranged social relations prevent this from occurring because they convert the fields of significance into mere possibilities without materialization. That is, the fields of significance open alternative paths of subjectivation to the subjects, but these are prevailed by estranged social relations, subjectively configured in social subjectivity. Let's take the example of students who have formed fields of significance, but who have poor results in tests. Any mathematics teacher can fill their hands with cases of this type. We are talking specifically about those subjects who outside the tests achieve objectification and creative learning, whether with manual work (*maker education*), or with digital game programming, etc. We realize that these students perform poorly in tests, but have a social practice with very advanced cultural objectifications. From the analysis of these cases of students, we observed that they form fields of mathematical significance and, therefore, open their own paths of subjectivation

out of its purely natural-biological explanation based on neuroscience. Despite bringing good inputs, its explanation is a positivist fetish.

that are sometimes confronted with the social subjectivity of the Mathematics class configured by the tests, by the grades. This action of confronting can develop as subjectivations *of* the confrontation with social subjectivity, generating indiscipline and questioning. On the other hand, which is more usual, it produces subjective senses that inhibit the cultural practice of these students in the classroom and in daily life, constituting negative conceptions about themselves. This is nothing new, or should not be, since the pioneering work of 1986 entitled *Na Vida Dez, Na Escola Zero* (NUNES; SCHLIEMANN; CARRAHER, 1986). Mathematics, in the ideological-estranged dimension, is the most important science to stand in the way of integral human development.

It is on this that the complex and estranged unity of truth and error is constituted. These estranged paths of subjectivation are articulated around the paradigm of exercise in the classroom, in which all cultural productions and subjective senses are linked to it. Understandings of truth and error are symbolic productions of culture that constitute a complex symbolic system. In the ideology of certainty of mathematics, this symbolic system is articulated around a binary thought, either it is right or it is wrong. Thus, the symbolic representations of Mathematics as a cultural system, in the course of the action of learning, are limited to two possibilities of subjectivation, one positive and the other negative, one desired and the other denied. In this binary cultural system, all discussion of creativity is extirpated, and the rigor that is always attached to creativity is fetishized as a dimension of mathematical accuracy. In this way, the symbolic productions of the true/right generate subjective senses of positive emotionality that reinforce this binary view, while the symbolic productions of error, from which creativity emerges, produce subjective senses associated with a negative emotionality that interposes any possibility of creation and alternative ways of subjectivation.

It is based on this binary system of symbolic-cultural representation of Mathematics that the ideology of certainty contributes to another set of estranged mathematical subjectivations that hinder the constitution of fields of significance.

As we have previously analyzed, the conformation of the fields of significance from the subjective configurations of the action of learning

Mathematics opens a field of possibilities for symbolic-cultural practices crucial for social objectification in symbolic systems. If learning is a complex symbolic-emotional process responsible for the conformation of fields of significance from symbolic systems constituted in social subjectivity, the cultural practice of the subjects is fundamental for the proper reproduction of these fields as subjective production in the configuration of new symbolic systems about reality. In short, every action of learning Mathematics implies, not linearly as a forerunner-consequence, but concomitantly, its cultural objectification. Every action of learning alludes to an action of objectification, that is, of activity.

The course of the action of objectification of the fields of significance as symbolic-cultural systems, with regard to the complex of Mathematics Education, is oriented and guided by subjective configurations of the action of mathematization. On the other hand, mathematization can occur in a strange way due to the influences of the ideology of mathematical certainty (BORBA, 1992), and thus constituting symbolic representations of reality that prevent full human development, such as the system of grades and credits that is a strange mathematization of the phenomena of learning.

The subjective dimension of the action of mathematizing is organized as a subjective configuration that generates and is generated by subjective senses linked to the process of objectifying symbolic systems conformed in fields of significance. In the course of the action of mathematizing, as well as in the course of the action of learning mathematics, not only subjective senses configured by the fields of significance are generated, but by all the others involved in this process. This subjective configuration is directed towards a social objectification, towards a cultural-symbolic production and, therefore, is precisely activity. If in the course of the action of learning Mathematics the field of significance opens possibilities for the realization of new symbolic-cultural productions, in the course of the action of mathematizing these objectifications are carried out. In the subjective configurations of the action of learning Mathematics, the fields of significance orient the action towards the personal, individual, while in the action of mathematizing the action is oriented towards the social. Being oriented towards any of these levels does not imply anticipation-consequence, much less the

possibility of separation. This process is constituted by a dialectical-configurational logic.

From its subjective dimension, the action of mathematizing is to culturally objectify a symbolic system generated by subjective senses configured in the field of significance. To culturally objectify a symbolic system, from a field of significance, is to create and imagine what has already been created and imagined. Ricoeur (1994) understands this process well and defines with it that to create is to unfold meanings. This way of understanding creativity fits the processes we analyze here, since in the course of the action of mathematization, subjective senses are produced from a system of subjective configurations generated by subjective senses from other moments. However, these new subjective senses occur in a process of qualitative leap of subjectivity caused by the field of significances, precisely by the expansion of cultural possibilities of the subjects' practices. That is, to mathematize is precisely to unfold meanings of and in the field of significances.

Both the subjective configuration of the action of learning Mathematics and the action of mathematizing cannot be reduced to their individual or social levels, although they are directed to each of these respectively. The field of meanings is not different from the subjective configurations previously analyzed, since the course of these actions takes place in social and relational contexts, implying the existence of the other in this dynamic. No one learns or mathematizes in isolation and alone, however, if one is oriented to the individual and the other to the social, a field of particular mediations is imposed that are configured around the action of dialogue. That is, the field of significance of the social complex of Mathematics Education is subjectively configured in three dominant configurations: the action of learning Mathematics, the action of mathematizing and the action of dialoguing.

The importance of dialogue for learning and social practice is not new in the field of education, and has already been treated in depth by both the Cuban author and a very important Brazilian author, Paulo Freire. While the works of Gonzalez Rey discuss dialogue in a communicative dimension linked mainly to epistemological aspects of qualitative research, Freire (1987) analyzes dialogue as

a constituent part of education. The dialogue in Freire (1987) is articulated with a vision of education as a practice of freedom, of action in the world transforming it and as a process of continuous humanization of the subjects. This transformation of the world and the humanization of subjects requires openness to the new, humility as an incomplete subject who always seeks something more to learn, and in short, must allow and promote reflection and creation in the world. For Freire (1987), dialogue implies the word in its two dimensions, action and reflection, but the latter, as we have already analyzed, is a symbolic-emotional production of subjectivity in the course of actions, in line with the author's famous statement: "there is no true word that is not praxis" (FREIRE, 1987, p. 44).

With regard to the complex of Mathematics Education, dialogue implies pronouncing the world with the words of Mathematics, that is, with its symbolic-cultural systems, but as every word is only authentic in *praxis*, that is, concrete and subjectively configured social practice, dialogue requires pronouncing Mathematics by mathematizing the world, so the pronunciation of the world by Mathematics is configured as dialogue, how to learn and mathematize. But to pronounce the world is to transform and humanize it, it is to recreate it continuously, to unfold the meanings articulated to it. Pronouncing the world is a practice of liberation, so it has no relation to the strange ways of mathematizing and learning Mathematics. Pronouncing the world is a process of developing humans integrally, in which the subjective development of the subjects demands the development of the human race.

The subjective dimension of dialogue is configured not as a relationship between one and the other, between subjects, but as a meeting of subjects mediated by the world. In the complex of Mathematics Education, the subjective dimension of dialogue is the meeting of subjects mediated by the field of significance generated in the course of this dialogue. However, dialogue does not admit hierarchies between those who know and those who do not. It is a relational system in which subjects relate to each other in a dimension "with", and not "for" or "over". There is no field of significance without its configuration in the action of dialogue, because this implies the "unbreakable solidarity" of the subject-world not admitting this type of dichotomies, and in this unbreakable solidarity there is no

refuge for finished subjects, but for developing subjects, in a continuous process of subjectivation.

According to Freire (1987), the dialogicity of educational processes constitutes critical thinking, as opposed to naïve thinking. Naïve thinking is directed towards accommodation, towards what is normalized in the world, while critical thinking is directed towards the continuous transformation of reality towards the humanization of the subjects. Naïve thinking is linked to mimetic-reproductive learning (MITJANS MARTINEZ; GONZALEZ REY, 2017) in which work is reactive to information, focusing on the cognitive and preventing subjective development, while critical thinking is articulated with creative and comprehensive learning. According to Mitjans Martinez (2012), comprehensive learning is directed to the understanding of the object under study, in which the active subject is emotionally engaged in the understanding of this object. However, the whole process takes place around this object and, in its understanding, without being directed to new processes that open alternative paths beyond what is given about this object. Comprehensive learning is when individuals constitute themselves as agents in the course of the action of learning, that is, they constitute fields of significance without, however, seeking ways to objectify new symbolic-cultural systems. On the other hand, creative learning is that which opens possibilities to a much more complex learning directed to new ideas, to alternative ways of subjectivation in relation to what is established in a social space, and that thus in the fields of significance makes individuals emerge as subjects who learn, who aim at new symbolic systems in culture, which requires the creative learning of Mathematics. However, in order to understand how these processes are constituted in their subjective dimensions, we need to stick to two specific subjective configurations: creativity-rigor and instruction.

3 The complex unity of creativity-rigor and instruction

Creativity as a concept is determined by two main notions, the new and the valuable. To create means something new that is interpreted as valuable by others (MITJANS MARTINEZ, 2012), so creativity always implies the field of the subject who creates and the field of social subjectivity that values. Human action is always

motivated, that is, the motives are not external to those who act, so every subjective configuration is always a motivated configuration. On the other hand, motivation is a constituent of the generation of subjective senses that are organized into a system of more stable subjective configurations of the personality, and, therefore, the personality is always a motivated subjective system. That is, there is no such thing as an unmotivated subject. The point is that this motivation is generated by a flow of subjective senses arising from different social spaces and different subjective configurations of the personality, so that it is impossible to define the genesis of the motivation of a given action.

From this process two things can be understood: the first that creativity is self-motivated in subjectivity and at its social level is configured, among other ways, in *should-be*, that is, in a symbolic representation of social necessity, *value*; and the second, *should-be* is the social subjective dimension of this complex of social objectivity. Thus, in the course of the subjects' action, the self-motivated subjective configurations are influenced by the social subjective configurations of the *should-be*. It is in this way that we can understand the way in which each of the mathematicians of Cauchy and Weierstrass's time interpreted the social need for a mathematical analysis, each constituting in their own way an understanding of rigor.

In mathematics, creativity is constantly valued by social needs, but also limited by the symbolic-cultural representation of value, while from the symbolic processes of mathematical rigor emerge the possibilities of creativity. It is enough to remember that during a period before Cauchy and Weierstrass it was believed that all mathematical problems had been solved and that the end of this science was increasingly being reached. First, the creativity with which Cauchy and Weierstrass produce mathematical analysis is directly linked to the creation of a new conception of rigor based primarily on later formalist bases. In summary, Cauchy's creativity is to redefine the period of mathematical experimentation (STRUİK, 1992) on a new basis of rigor. Cauchy's specific motivation is impossible to understand, however the subjective social configuration of the *should-be* is linked to the constitution of new schools in the Napoleonic period and the growing need for Mathematics for French society, which implied a systematic organization

of the mathematical field for its better teaching (WAGNER, 2022; STRUIK, 1992). From this point on, the *should-be* interposed to the social subjectivity of European mathematics a new type of organized symbolic system, a new rigor, where the creativity of some prominent mathematicians acted.

With this, we understand that in the complex creativity-rigor unity, rigor does not necessarily limit the field of creativity, but challenges types of creativity that go beyond itself. The creative character of Cauchy's mathematical analysis was an alternative way of mathematical subjectivation of the period, a way so powerful that it reconfigured the organization of its symbolic system. However, this was also only possible on the one hand due to the subjective social configuration of a *should-be* that allowed and positively valued this creation, and on the other hand due to a new type of rigor that was capable of dialectically incorporating the rigorous forms that Mathematics organized itself in past periods. In other words, mathematical analysis was constituted as rigor in this period precisely because it was a rupture with continuities. That is, the objective qualitative leap from the *formal* was only possible due to the qualitative leap made by the subjective reconfigurations organized around the subjective senses of creativity-rigor. From this analysis another fundamental question emerges, the subjective senses of creativity-rigor are not predominantly symbolic, they are not directed to an objectification in culture in the form of symbolic systems, and even so, they do not have an auxiliary role in the fields of significance. That is, the fields of significance do not predominate over other subjective configurations, and, therefore, any attempt to see in the fields of significance subjective definitions of the process of mathematical production is doomed to failure.

With this analysis we understand that the subjective configurations of the complex unit creativity-rigor constitute the fundamental influence on the processes of the fields of significance, being a participant in learning and mathematization. In summary, in the complex of authentic Mathematics Education, that is, not estranged, learning and mathematization are implied and imply the subjective configurations of creativity-rigor. As we have previously discussed, to create is to unfold meanings, to generate alternative ways of subjectivation that are valuable for social subjectivity, and this value in

Mathematics is linked to the meanings of rigor, so that in the subjective dimension of Mathematics Education, creating implies rigor, which implies creativity.

The rigor implying the creativity of those who learn and mathematize corresponds to the fact that it is not just any type of symbolic production that will be positively valued by mathematical culture. It needs to follow some socially configured criteria. Therefore, any type of symbolic production is not accepted, which imposes on the subject who learns Mathematics a need to generate subjective senses and constitute new subjective resources promoting their subjective development. To generate new subjective senses that meet this demand of *the socially configured should-be* in mathematical culture is to unfold senses that the subject already had, it is to develop subjectively, to create. Therefore, the subjective configuration of creativity-rigor is fundamental to the subjective development of those who learn, and a necessary condition for the possibility of integral human development.

The way in which this flow of subjective senses of creativity-rigor is configured is unique for each subject, since it implies the most stable subjective configurations of personality, fields of significance, the course of action of learning Mathematics, mathematization and dialogue. This singularization follows a configurational logic, which is recursive and iterative, unstable and dynamic.

In another work (WAGNER, 2022) in which we analyzed the emergence of the Mathematics Education complex, *Matema*, we explained how the complex units of transmission-construction and teaching-learning were articulated, in which in their tensions they constituted the social complex of instruction within *Matema*. At that time, we explained that the articulated processes of transmission-construction and teaching-learning were precisely social and that they achieved their singularization from a field of particular mediations that constituted the complex of instruction, being of Didactics⁵. This complex is responsible for individuation from Mathematics Education.

⁵ It is not within the scope of our work to discuss the field of mathematical didactics as a social complex responsible for the constitution and study of instruction. It is worth mentioning that didactics is usually defined as the science of the teaching-learning process, but as we have explained elsewhere (WAGNER, 2022), this process is not singular, individual, but a social objectivity. The teaching-learning process achieves a singularization from the instruction complex,

As social objectivity directed to the process of individuation and singularization of subjects, that is, the formation of subjectivities, the complex of instruction necessarily has a configured subjective dimension. There is even more precious in this aspect, in education the configured subjective dimension is the predominant moment. Because it is directed to subjectivity, its object is the subjective field, inaugurating a subject-subject relationship, and as we have already explained about the structure and nexus of social complexes in their objectivity, it is the object that holds ontological priority over the teleological positing unleashed. In short, this contradicts most Marxist references that tend to focus the ontological priority of education on objective social structures rather than on subjectivities⁶.

All the previous exposition on the dialectical-configurational logic of the fields of significance, their constitutions based on subjective configurations of the action of learning, mathematizing and dialogue, associated with the more stable subjective configurations of personality and creativity-rigor, express the subjective conformation of the social complex of instruction. That is, the generation of subjective senses conformed by this system of subjective configurations of instruction in *Matema* that we conceptualize as mathematical subjectivations.

In the first sections of this article, we analyze how different experiences generate unique subjective senses in each subject, and we also discuss how subjective senses are generated in the course of the action of these experiences. In addition, at certain times we speak of experience, or living, and at others of experience or experimentation. These differentiations throughout the text did not appear randomly. To discuss this, we return to what Vygotsky (2018) understood by experience, or *perezhivanie*. Experience, the Soviet author explains, is the unity of environment and individual, it is indivisible, where at one pole is what is experienced and at the other how a subject experiences it. This, as a unit of environment and individual, is always articulated with the social space in which

with instruction being the mediating social complex that, through *Matema*, educates individualities as social beings, that is, it produces human culture in each individual.

⁶ This does not configure, not even closely, a perspective of learning to learn. Such perspectives are subjectivist, they deny the objective dimension of education, which is not our case.

the experience occurs. In this aspect, every experience generates multiple subjective senses that are configured in the course of the experience. However, what is the difference between experience and living?

In Dewey (1958), experience is not a simple production of sensations, but is elastic and deepened, directly linked to the reflective character of cognition. That is, for this author, experience is associated with the action and reflection of what is experienced. Taking inspiration from this way of thinking about the experience of the American philosopher, we can reinterpret it with our investigative key. Since experience is implied in action and reflection, it is precisely a process that generates subjective senses, because it is action. On the other hand, as a generator of reflections, it constitutes a symbolic production about what has been experienced in order to think about it. In our view, this is how we can understand when Dewey speaks of plasticity and penetration into the object of experience.

Resuming our discussion, experience is the set of subjective senses generated in the course of an experience with symbolic predominance, that is, it is a field of significance of experience. On the other hand, experience does not end in living, it goes beyond it and generates subjective senses that do not skip the possibility of intelligibility. Experience is a symbolic-emotional production brought to "consciousness", that is, they are the zones of sense capable of generating intelligibility in the form of symbolic systems about the experienced experience.

We have previously analyzed how the fields of significance positively influence subjective development, an important finding for what we mean by mathematical experiences. These experiences generate mathematical subjectivations, but are associated with the symbolic-emotional processes of *Matema*. We understand mathematical experiences as any action that occurs in a social space in which there is mediation with symbolic constructions of mathematical culture: in the market, on the street, at work, in the hospital, and of course also at school. However, the classroom or the processes linked to a mathematical subjectivation are a specific field of mathematical experiences that differ from the others due to the objective organization of the Social Being.

To discuss mathematical experiences, I want to bring up two studies, in my view fundamental for Mathematics Education. One already mentioned above, *Na*

Vida Dez, Na Escola Zero, and another entitled *Uses and Language Games in Mathematics: Dialogue between Philosophy and Mathematics Education* by Denise Vilela (2013). These studies establish the existence of different ways of symbolically producing mathematical culture, and point out that these productions are linked to the social space in which they occur. That is, as Mathematics is not limited to the school and the classroom, there are other ways of experiencing it, and in the vast majority of these other forms it is just another symbolic production of the great cultural fabric established.

Thus, mathematical experiences correspond to the different processes of subjectivation that occur in spaces permeated by mathematical culture, without this necessarily being the main one. The understanding of this experience allows us to study subjectivations related to Mathematics in spaces outside the classroom and school, and thus we can minimally understand the impact of these other experiences on the mathematical subjectivations that occur in the context of the social complex of *Matema*.

However, in order to understand these impacts of mathematical experiences on the subjective configurations that are organized in the course of mathematical instruction, it is necessary to constitute zones of intelligibility, which are possible from mathematical experiences. These experiences are thus fields of significance, with subjective configurations that are organized according to the cultural space in which the experience occurs, capable of generating subjective senses linked to the intelligibility of the processes of mathematical experience.

The mathematical experience of the family, race, teachers and so on, based on the experiences generated, is subject to intelligibility, and thus to understanding its impacts on mathematical subjectivations. This experience implies a subjective reconfiguration related to the symbolic-emotional productions that one has about Mathematics. Thus, if a student has a family that places a conception that Mathematics is difficult, subjective senses generated by this experience are configured. If another student has a teacher considered an executioner and ill-mannered, the subjective senses generated by this student will be marked by this established cultural space. Mathematical experiences and their

study from experience allow us to found zones of intelligibility beyond the Mathematics classroom. Every mathematical experience constantly redesigns the subjective configurations that emerge from the social complex of instruction in *Matema*, therefore, its study is fundamental for understanding the possibilities of emergence of subjects in Mathematics Education and in overcoming estranged mathematical subjectivations.

4 Final considerations

The category of fields of significance and their dialectical-configurational constitution allows us to consolidate an ontoepistemological approach to the research of mathematical subjectivations, since it seeks to highlight and promote heuristic tools that direct the understanding of the particular field of mediations and transitions between the subjective and objective dimensions of the Social Being and, with more specificity, of the *Matema complex*.

In view of this discussion, we understand that there are certain subjective configurations that are characterized in a particular way in Mathematics Education and, therefore, subjectively allow mathematics to constitute itself as a symbolic system over reality and to be able to form zones of intelligibility about the world, as well as to produce structural social objectivities.

On the other hand, it allows a more focused investigation of Mathematics Education on the impacts of social structures on the processes of subjectivation related to mathematics itself and differentiating processes that point to integral development from those that conform to social estrangements.

Subjetivaciones Matemáticas y el surgimiento del sujeto en la Educación Matemática: una perspectiva histórico-cultural

RESUMEN

Este artículo busca contribuir teóricamente a la Teoría de la Subjetividad desde la Educación Matemática, al mismo tiempo que desarrolla, a partir de la Teoría de la Subjetividad (TE), una comprensión teórica de las subjetividades matemáticas. Se toma como referencia para las discusiones las teorías del TS y la filosofía de Lukács. Los resultados encontrados son las categorías de campo de significación y su constitución como una lógica dialéctico-configuracional y la ruptura de las configuraciones subjetivas de la acción de aprender matemáticas, la acción de matematizar, el diálogo y la creatividad-rigor. Finalmente, se estableció un poderoso marco heurístico para

investigar los procesos subjetivos en la Educación Matemática, tomando como nivel la interrelación objetivo-subjetiva del Ser Social.

Palabras clave: Teoría de la Subjetividad. Educación Matemática. Subjetivaciones. Lukács.

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