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Meanings of Interdisciplinarity Attributed by Mathematics Teachers' Educators and Teachers of the Municipal Schools of São Paulo

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ABSTRACT

Background: within the scope of public educational policies, the research focuses on the recontextualisation of the principle of interdisciplinarity of the Programa Mais Educação São Paulo (More Education Programme) for mathematics teachers' pedagogical practices. **Objective:** to discuss the meanings attributed to interdisciplinarity by mathematics teachers' educators and teachers. **Design**: we used Basil Bernstein's curriculum theories and the theory of the pedagogic device, exploring the concepts of pedagogical recontextualisation and pedagogical practice. We conducted qualitative research of a deductive-interpretative nature. **Settings and Participants**: the subjects are mathematics teachers' educators involved in implementing the programme and mathematics teachers working in the Interdisciplinary Cycle in the municipality of São Paulo. **Data collection and analysis**: we used semi-structured interviews, as they allow the production of singular meanings of the subjects' perspectives on the process of recontextualisation of the principle of interdisciplinarity. Data analysis was performed by theme/category-based content analysis. **Results**: as the discourse of interdisciplinarity is moved to pedagogical practice, educators and teachers reveal conceptual and methodological gaps to carry out interdisciplinary work in schools. When working from an interdisciplinary perspective, they opt for integrative projects, which has already been carried out through the methodology of the generating themes. **Conclusions*:*** we clarify the need to invest in an interdisciplinary teacher education model to change the logic of a fragmented school disconnected from contemporary issues. We argue that in this globalised world we live in, permeated by complex issues, we can no longer be restricted by the boundaries of an area of knowledge.

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Keywords: Programa Mais Educação São Paulo; Public policies; Interdisciplinarity; Recontextualisation; Curriculum.

Sentidos de Interdisciplinaridade Atribuídos por Formadores e Professores de Matemática da Rede Municipal de Ensino de São Paulo

RESUMO

Contexto: no âmbito das Políticas Públicas Educacionais, a pesquisa foca a recontextualização do princípio da interdisciplinaridade do Programa Mais Educação São Paulo para as práticas pedagógicas dos professores de Matemática. **Objetivo:** discutir os sentidos atribuídos à interdisciplinaridade por formadores e professores de matemática. **Design**: recorremos às Teorias de Currículo e à Teoria do Dispositivo Pedagógico, de Basil Bernstein, explorando os conceitos de recontextualização pedagógica e prática pedagógica. Realizamos uma pesquisa qualitativa, com cunho dedutivo-interpretativo. **Ambiente e Participantes**: os sujeitos são formadores de Matemática envolvidos na implementação do Programa e professores de Matemática atuantes no Ciclo Interdisciplinar no município de São Paulo. **Coleta e análise de dados**: utilizamos entrevistas semiestruturadas, pois permitem a produção de significados singulares das perspectivas dos sujeitos sobre o processo de recontextualização do princípio da interdisciplinaridade. A análise dos dados foi realizada pela Análise de Conteúdo Temático-Categorial. **Resultados**: na medida que o discurso da interdisciplinaridade é movido para a prática pedagógica, formadores e professores revelam lacunas de ordem conceitual e metodológica para efetivar o trabalho interdisciplinar nas escolas. Ao trabalhar em uma perspectiva interdisciplinar, optam por projetos integradores, o que já se efetivou por meio da metodologia dos temas geradores. **Conclusões*:*** iluminamos a necessidade de investir em um modelo de formação de professores que também seja interdisciplinar se queremos mudar a lógica de uma escola fragmentada e desconectada das questões da contemporaneidade. Defendemos que no mundo globalizado em que vivemos, permeado de questões complexas, não é mais possível ficar restrito às fronteiras de uma área do conhecimento.

Palavras-chave: Programa Mais Educação São Paulo; Políticas Públicas; Interdisciplinaridade; Recontextualização; Currículo.

INTRODUCTION

The curriculum and administrative reorganisation, expansion, and strengthening of the municipal education– Programa Mais Educação São Paulo – was a public policy conceived at the end of Fernando Haddad's first year as mayor of the municipality of São Paulo (2013). Being introduced as an innovative proposal, the programme aimed to improve the quality of public

education offered in municipal schools and rethink the social function of the school.

The programme was presented at the beginning of 2014, through the document entitled *Programa Mais Educação São Paulo: Subsídios para a implantação* [More Education São Paulo: Subsidies for the implementation] (São Paulo, 2014). Its purpose was to detail the principles of educational policy, justify and explain the changes proposed, and clarify fundamental points of curriculum reorganisation. Those subsidies were presented in a series of technical notes.

Nota Técnica No. 3 [Technical Note], in particular, proposed a significant change for municipal schools: the organisation of the nine-year elementary school in three cycles of three years each, called the Literacy Cycle (1st to 3rd grade), the Interdisciplinary Cycle (4th to 6th grade) and the Authorial Cycle (7th to 9th grade). The organisation's prerogative in learning cycles brought concepts of formative assessment, complementary pedagogical monitoring, and learning recovery strategies. It also advocated a curriculum structure focused on quality education (São Paulo, 2014).

> The organisation in cycles is considered the most appropriate - and the most demanding - structure from the point of view of the battle against school failure. It requires a curriculum structure that favours continuity, interdisciplinarity, and progression, fundamental principles for quality education. It implies action and collective responsibility. (São Paulo, 2014, p. 74)

In turn, *Nota Técnica No. 5* dealt with the specificities of the Interdisciplinary Cycle and presented interdisciplinarity as the guiding thread of the teaching and learning processes. Therefore, it assumed the integrated work between the areas of knowledge of the curriculum.

> The cycle referring to the 4th , 5th, and 6th grades of elementary school, called the Interdisciplinary Cycle, will continue the alphabetisation/literacy process to increase autonomy in reading, writing, and problem-solving skills. Besides art, physical education, the study of a foreign language, human sciences, and nature, which will be addressed with specialist teachers to contribute to the development of students for the exercise of citizenship. (São Paulo, 2014, p. 78)

In this text, an excerpt from Silva's doctoral thesis (2020), we sought to rescue and discuss the meanings attributed to interdisciplinarity by teachers of the municipal education of São Paulo (RMESP). Together, we address the recontextualisation of this aspect of the Programa Mais Educação São Paulo for mathematics teachers' pedagogical practices.

For Bernstein (1996), pedagogic recontextualisation concerns the movement of a text, from its context of origin to another scenario, in which it changes as it relates to other texts. Agreeing with this premise, we consider that the principles of curriculum reorganisation, along the lines of the Programa Mais Educação São Paulo, are not automatically incorporated by teachers. On the contrary, teachers reread and interpret the texts of curriculum proposals in dynamic processes that can even substantially change them. For this reason, we are interested in analysing how the mathematics teachers and teachers' educators recontextualised the principles of interdisciplinarity. In other words, we want to understand the transposition of what is present in the programme texts to their pedagogical practices.

However, we first highlight how the concept of interdisciplinarity appeared at other times and curriculum documents of the municipal education of São Paulo and resumed by the Programa Mais Educação São Paulo.

INTERDISCIPLINARITY IN THE MUNICIPAL EDUCATION OF SÃO PAULO

The proposal for an integrative or interdisciplinary curriculum has been defended among Brazilian authors since the 1970s, based on the contributions of researchers such as Hilton Japiassu (1976) and Ivani Fazenda (1979) (São Paulo, 2016). However, we know that most Brazilian schools have consolidated the disciplinary paradigm in their curriculum organisation, with well-defined limits between the areas of knowledge.

Interdisciplinarity as a curriculum principle in the city of São Paulo was present during Mayor Luiza Erundina's term in office (1989-1992). The principle had an openly political focus through the integrative methodology of the generating themes, defended by Paulo Freire in his work *Pedagogia do Oprimido* [Pedagogy of the Oppressed] (1996).

The methodology of the generating themes proposed "that knowledge be constituted to the extent that the areas are interdisciplinary, aiming at a critical reading of society" (São Paulo, 2016, p. 16). According to Weller

(2000), the schools chose the generating themes and dealt with specific aspects of the local reality. This experience began with a pilot project composed of ten schools from different regions of the city of São Paulo and was expanded in subsequent years so that, in 1992, 187 schools worked with the proposal of an interdisciplinary curriculum based on generating themes.

This experience in the municipal schools indeed served as inspiration and reference for the movement undertaken by the Programa Mais Educação São Paulo, since Paulo Freire's management as Secretary of Education of São Paulo left many marks, being often remembered "as who, by leaving, stays" (Weller, 2000). Thus, the interdisciplinary component was cited in the document "Subsídios" [Subsidies] (São Paulo, 2014) as one of the priority themes to be addressed in teacher education, constituting an essential part of the implementation of the curriculum reorganisation programme.

The relevance of the theme can be observed in the fact that one of the learning cycles of elementary school is called Interdisciplinary Cycle (4th to 6th grade), denoting that the programme brought in its very name the interdisciplinarity as one of the dimensions of the pedagogical work for the cycle. In the proposal, interdisciplinarity was taken as a facilitating principle of the

> [...] development of the contents by curricular arrangements between two or more disciplines, to provoke mutual integration, based on global and non-compartmentalised systems, as in the disciplines. The interaction can occur by the method, the procedure, and the teaching organisation. (São Paulo, 2014, p. 78)

Therefore, the Programa Mais Educação São Paulo indicates a curriculum organisation for the Interdisciplinary Cycle (4th, 5th, and 6th grades) that privileges interdisciplinary arrangements either by method, procedure, or teaching organisation. However, the programme lets the teachers decide how to implement interdisciplinarity in schools. The methodology of the generating themes is not mandatory; the programme highlights only that the students must be offered the opportunity to learn "to look into the same object of knowledge from the perspective of the different curriculum components" (São Paulo, 2014, p. 79).

Of course, organising the pedagogical work in the municipal schools of São Paulo to contemplate an interdisciplinary approach is never an easy task. Glimpsing this intricate enterprise allows us to raise various questions. After

all, how does school leave a logical disciplinary path and begin incorporating proposals that take into account the interdisciplinary dimension? Precisely about the implementation of the programme at stake, some questions permeated our research and data production path: How was the idea of interdisciplinarity received by schools? Was there any resistance? Which? How did mathematics teachers face interdisciplinarity based on the place and status that mathematics occupies in curricula?

METHODOLOGY

Considering the characteristics of the qualitative research (Creswell, 2010; Lüdke & André, 2017), we adopted semi-structured interviews to produce the data. Our choice for individual interviews lies in the fact that they allow the production of singular and, therefore, diversified meanings of the subjects' perspectives on the process of recontextualisation of the principle of interdisciplinarity.

The research subjects were chosen among mathematics educators involved in training actions related to the implementation of the programme and mathematics teachers working in the Interdisciplinary Cycle and/or Authorial Cycle. One of the criteria for selecting the research subjects was that the participants had to be working in different municipality regions. Also, when we mention mathematics educators, we are referring to mathematics teachers who, during data production, held a technical position in the Pedagogical Division (Divisão Pedagógica - DIPED) of some Regional Teaching Board (Diretoria Regional de Educação - DRE) of the city of São Paulo, therefore, performing a strategic function for the implementation of the programme.

From a methodological point of view, we consider it necessary to mention that, when choosing the subjects interviewed, we consider that the schoolshould be included in the listening movement as a context in which valid realisation occurs (Bernstein, 1996). Therefore, it was important to interview mathematics educators, who were linked to the implementation of the Programa Mais Educação São Paulo or, according to Bersntein (1996), to the Official Recontextualising Field (Campo Recontextualizador Oficial - CRO), and mathematics teachers, to try to understand how the proposal was translated by those who were in a central body and how they arrived "at the end" of the chain, the classroom, thus guaranteeing the multiplicity of looks.

Mathematics educators occupied the role of official recontextualising agents since they represent the Municipal Department of Education (Secretaria

Municipal de Educação - SME). The teachers, in turn, worked as pedagogical recontextualising agents, whose primary function was to take the discourses present in the Programa Mais Educação São Paulo to the pedagogical practice (Bernstein, 1996).

In this text, we bring the meanings of interdisciplinarity attributed by two mathematics educators, Carlos and Cleide, and two mathematics teachers, Ana and Sofia, who we chose because their performance was directly related to the Interdisciplinary Cycle. Their subjectivities and their views on the process studied were particularities that interested us to collect and analyse.

With the transcripts of the interviews in hand, we started to carry out the "fluctuating reading", as proposed by Bardin (2016) and Franco (2018), which allowed us to choose the material that constituted the corpus of analysis. In the process of comings and goings to our corpus of analysis, we could apply the requirements of content analysis to create categories, regrouping empirical categories emerging from the data produced, renaming them, and assigning them the status of analytical categories, basis for our interpretation and inference.

RESULTS AND DISCUSSION

The first difficulty that appears when interdisciplinarity is discussed is in the conceptual and methodological dimensions of the theme, i.e., in how to understand the teachers' notions of interdisciplinarity, on the one hand, and the different ways in which they recontextualised the discourse from interdisciplinarity to pedagogical practice, on the other.

Etymologically, in a broad sense, interdisciplinarity means the relationship between disciplines that are open to the new connections that are established between them. Thus, "interdisciplinary is any interaction existing between two or more disciplines within the scope of knowledge, methods and learning thereof" (Suero, 1986 apud Fazenda, 2008, p. 162). Therefore, interdisciplinarity is a theme with its theoretical contribution and a conceptual approach that needs to be elucidated when teachers are expected to adopt it as a perspective.

In one of the texts of the Programa Mais Educação São Paulo, we found that

> [...] an interdisciplinary approach assumes that each area can work in the interface with other areas, i.e., it does not cease to

> have its own characteristics, but understands its epistemological relationship with the others. Therefore, it is independent and should not neglect its object, which is its own, but, in the construction of this object, seek relations with other areas. (São Paulo, 2016, pp. 65-66)

Therefore, it is evident that interdisciplinarity does not dispense with disciplines but depends on its structured organisation, given that it is relational. "To the extent that school subjects have their sources of organisation situated in the reference knowledge, it is also from the reference knowledge that integration is thought" (Lopes & Macedo, 2011, p. 131).

Considering interdisciplinarity presupposes taking the disciplines and their objects of knowledge seriously while thinking of establishing relations between them based on common problems and themes located in the disciplines of reference.

However, in more recent approaches to the subject, it is noteworthy that interdisciplinarity is now considered as a "new attitude in the face of the issue of knowledge, of openness to the understanding of the hidden and the apparently expressed aspects of the act of learning" (Fazenda, 2001, p. 11). Alternatively, as Japiassu (2006) warns, the question of interdisciplinarity "must be understood as an attitude [...] without the illusion that the simple contact of scientists from different disciplines is enough to create interdisciplinarity" (p. 27).

Those authors suggest that interdisciplinarity should mean a change in the pedagogical stance of teachers, the inclusion of new points of view, new ways of working and organising the curriculum. Thus, even though teachers are experts in some areas of knowledge, they must take a different posture and be open to an interdisciplinary approach as they venture with their students in other curricular components. The text of the Programa Mais Educação São Paulo agrees with this point of view by stating that

> To the teacher, interdisciplinarity implies a change of epistemological and methodological attitude in the pedagogical practice and, consequently, transforms the process of teaching and learning between teacher(s) and student(s) in the school context, not as any practice that can be applied, but as the opening to a new way of thinking and acting. (São Paulo, 2014, p. 79)

Still in the field of the conceptual dimension, we realise that we must distinguish interdisciplinarity from 'multidisciplinarity' 'and 'transdisciplinarity,' two terms that often generate confusion.

Multidisciplinarity, equivalent to pluridisciplinarity, is defined as the juxtaposition of ideas and search for integrating knowledge through the study of an object of the same and single discipline or by several of them simultaneously. However, in a multidisciplinary approach, the boundary between disciplines remains. The contents are seen in a compartmentalised way, and one does not need to establish relations between the different areas of knowledge. Teachers do not need to talk to their colleagues or know what topics they address in other disciplines. The disciplines act independently, within well-defined boundaries. It is the most present disciplinary relationship in traditional school curricula (Bicalho & Oliveira, 2011).

Interdisciplinarity, in turn, proposes less rigidity between the limits around each discipline, aiming to use the knowledge of the various areas to solve a problem or answer a question. We can cite the transversal themes (ethics, environment, health, cultural plurality, and sexual orientation) as an example of interdisciplinary objects proposed by the National Curricular Parameters (Parâmetros Curriculares Nacionais – PCN) (Brasil, 1997).

Transdisciplinarity emerged as a new way of integrating knowledge, reaching more profound levels of interaction, and overcoming disciplinary barriers. Its proposal is not only to establish relations between the disciplines but build something that transcends the knowledge established by them. In a transdisciplinary approach, the contents do not belong exclusively to a discipline. For example, the theme society can cross the boundaries between the areas of knowledge and can be studied from history, geography, biology, arts, anthropology and other fields. The concept of transdisciplinarity is under discussion and is currently being debated on a large scale in academia (Bicalho & Oliveira, 2011).

About the interpretation and recontextualisation of these concepts for pedagogical practice, Fazenda (2006) warns us that teachers often seek to develop an interdisciplinary proposal in their schools intuitively. However, due to the lack of rapprochement with theory, they end up executing projects that align more with multidisciplinarity, deluded by common sense that they are interdisciplinary.

Even though it is not a new subject in the municipal education of São Paulo, we know that many new teachers joined this network in recent years and

did not have the opportunity to discuss this theme in the school's collective schedules or continuing education courses offered by the DIPED. More than that, the teaching degree courses that those teachers attended – aimed at the education of specialists from different areas – were solely focused on the object of knowledge of that specific course. In other words, the courses did not establish connections between the areas of knowledge, imprinting a strongly disciplinary mark on the formative path of those teachers, who end up carrying this perspective in their teaching activities.

Bernstein (1996) categorises the disciplinary logic as solid classification and framing and, consequently, dimensions of power and control of the school curriculum. According to the author, the concept of classification refers to the power relations about "what" must be taught and learned. Classification is linked to the nature of differentiation between content and areas of knowledge. Where classification is robust, the contents and areas of knowledge are separated by strong limits, well-defined boundaries (and, therefore, direct power relations). In contexts where classification is weak, there is a reduced separation between content and areas of knowledge, and the borders are unclear (and, therefore, less clear power relations).

The concept of framing, in turn, refers to the control relationships that influence the "how" of the teaching and learning processes, the way such processes should be conducted. Bernstein (1996) explains that framing is linked to the degree of control of what is taught and received in pedagogical communication. A strong framing indicates that the teacher strictly regulates the sequencing, form, selection, timing, and discourse of the learning context. A weak framing suggests that the teacher has less control over the elements of pedagogical practice.

The interdisciplinary logic of strong classification and framing is a rule that operates in given pedagogical contexts and governs pedagogical practice. Evidence of those marks in teacher education are in the perspectives and meanings about interdisciplinarity presented by the research subjects.

Sofia, a mathematics teacher, shows that interdisciplinarity had not been considered in her practice until she participated in the formative action. She affirms that she had never studied the subject, not even in her initial education. Her closer involvement with the courses offered by the DIPED team was fundamental for her changing her conception and posture.

> *Regarding interdisciplinarity, for many colleagues and me, it was a completely new theme, and it was one of the things that*

> *appeared strongly in the proposal of the Programa Mais Educação São Paulo. Having participated in the training, having studied on this subject, all this was extremely important and made a lot of difference in what I am today, and what I think as a teacher because it was an aspect of the teacher's work that until then I had never stopped to think about, I did not study about it in college.* [...]
>
> *In mathematics school, we don't discuss many of these things, so I had to study a lot, I had to read a lot to be able to feel minimally safe. I feel that we, mathematics teachers, are very attached to the content, to how to work on that content; we do not worry about what that content has to do with other areas. We think that we only have to plan at the beginning of the year and try to fulfil it during the year, set up an assessment test to see whether or not the students learned the topic we addressed. However, when we study those matters more deeply, I realised that this alone is not enough, because if you ask why I work with this or that with my student, why this content is important, for what I want to prepare my student, all these questions are extremely important in our work as a teacher, but they are questions that we do not ask ourselves. The pieces of training showed me how much I know nothing, or almost nothing (laughs) and how much I still have to read, study, learn if I want my classes to be more interesting for my students*. (Sofia – mathematics teacher)

Sofia's statement shows that interdisciplinarity, for many teachers, proved to be a formative demand. By highlighting the concept, the Programa Mais Educação São Paulo raised the need for this training and signalled the relevance of discussing ways of organising the school curriculum with weaker classification and framing.

The formative gaps pointed to the fact that teams of educators of the DIPED had to prioritise interdisciplinarity to plan their courses, which included the need for the educators themselves to appropriate the theme theoretically. A conceptual alignment on the work with the Interdisciplinary Cycle was necessary among the teacher educators, as they needed to share the same discourse among the different Regional Teaching Boards.

> *What was our difficulty as a team? As a team, there were basically two: What we are calling interdisciplinarity, of the*

> *Interdisciplinary Cycle, what is it? And how we work with interdisciplinarity breaking with the structured curriculum as it is, how we give autonomy to school, including autonomy for the teacher to propose the curriculum, think about topics to address and break with this structure so crystalised that we know it is a traditional curriculum.* (Carlos – mathematics educator)

When it comes to breaking with a fragmented curriculum, Carlos's statement highlights two aspects that permeate the current curriculum discussions: the teacher's autonomy as a curriculum producer and the need to seek interdisciplinary themes that are relevant and interesting for students.

Regarding the teacher's autonomy in proposing curricula, Giroux (1997) warns us that it is necessary to rethink and restructure the nature of the teaching work, considering teachers as intellectuals and not as mere technical/instrumental that only reproduce the prescribed curriculum. However, for this to happen, a set of ideological and practical conditions is necessary, since taking teachers as transforming intellectuals means defending that those professionals can take active responsibility for the production and legitimisation of serious questions about what they want to teach and how they want to teach. Ana, a mathematics teacher, explains how this process happened in her school:

> *Last year [2017], we worked on a project with the eighth grades about the neighbourhood; it was we, teachers, who chose this theme because we thought we had a lot to work on. So, I worked with the geography teacher, who is also the Professora Orientadora da Sala de Leitura - POSL [Guiding Teacher of the Reading Room], and with the other mathematics teacher of the Authorial Cycle, the three of us were responsible for this project. The other teachers from the other disciplines helped when it was possible because they were also involved in other projects.* (Ana – mathematics teacher)

Ana's speech explains that the teachers' autonomy and authorship in tracing directions for the curriculum, in the case of her school, emerged through their choice of a theme (weak classification) and the choice of project methodology (weak framing) to try to put into practice the intersection relations between the boundaries of mathematics and geography (Bernstein, 1996).

However, Ana admits how difficult it is to include other teachers in the proposal. About the work with projects, she argues:

> *In the school where I work, we are very involved in working with projects, so we started at this pace. This year [2018], I teach the sixth and ninth grades, and as each grade has its specific project, the ninth grade has the TCA [Collaborative Authoring Work] during the school year, we produce workshops to work on this project, we discuss with students the research they will develop, what the presentation will be, what the final product will be. And all this we ended up introducing into the daily life of our school because of the Programa Mais Educação São Paulo, because it brings this issue of working with projects and interdisciplinary work very strongly. So, we saw it that way. I think that if it were not for the programme, we would have remained in our own spaces (to each our own) and would not have made this effort to think about projects.* (Ana – mathematics teacher)

From a methodological point of view, we realised that the work with the projects was configured as one of the strategies chosen by the teachers at the school where Ana teaches as the most suitable for an interdisciplinary approach, to put into practice what was proposed in the Programa Mais Educação São Paulo. However, we emphasise again that working with projects is not the only way to do this and can also be covered through methodologies such as didactic sequences, experiments, research, environmental studies, among others.

Besides the points mentioned above, we want to highlight the institutional role played by the Programa Mais Educação São Paulo as a motivator and driver of the projects that were planned and developed in São Paulo's municipal schools. Therefore, the Official Recontextualising Field (CRO) was the trigger element for proposals relevant to the particular and local contexts of each educational unit to be developed and implemented (Bernstein, 1996). The document "Diálogos Interdisciplinares a caminho da Autoria" [Interdisciplinary Dialogues on the Way to Authorship] (São Paulo, 2016) points out that

> The origin of the interdisciplinary proposal may be in social issues, phenomena, or problems. What knowledge is mobilised so that the social issue is problematised? The perspectives of identifying problems, their analysis, and the construction of

> new knowledge are necessary in the search for solutions of social intervention and the understanding of human phenomena. [...] In this sense, there are numerous work methodologies, such as the constitution of projects or participatory research, which can constitute procedures capable of contributing to this process. (São Paulo, 2016, p. 66-67).

The choice of themes for the development of interdisciplinary projects was, therefore, a central part of the work of the teachers of the Interdisciplinary Cycle since, as we have already pointed out, the Programa Mais Educação São Paulo did not prescribe how the topics should be addressed or how the projects should be developed, giving schools autonomy.

However, the fact that the programme shed light on interdisciplinarity as a principle of an institutional public policy while not prescribing, presented advantages and disadvantages. On the one hand, we can say that it was a way to give way to the teachers' autonomy, to provide opportunities for authorial projects of different configurations, considering all the particularities of a complex city such as São Paulo. On the other hand, an open and flexible curricular arrangement could motivate other types of approaches, from the most innovative and relevant to the school territory to proposals emptied of meaning, made without discussion among teachers, coerced in some cases and, in others, with mistaken translations of curricular principles. An open, non-prescriptive configuration could even mean a 'non-doing,' a project that is 'only on paper.'

> *In the beginning, in the formation of the PEA - Projeto Especial de Ação [Special Action Project], we studied this theme a lot, and the concern was more about how we can work in each project, with all disciplines, how all teachers can fit in, so the direction and coordination of the school, and we teachers, were all concerned about it. But in the project that was chosen for that school year, I will be honest with you, there is a lot that I worked on only mathematics, the Portuguese teacher worked only Portuguese, the interdisciplinarity, really, was only on paper.* (Ana – mathematics teacher)

Ana's statement is an example of the complexity of operating the recontextualisation of interdisciplinarity for pedagogical practice. Although it

was the object of training in[1] the school's PEA schedules, there was a concern, including from the management team, to involve all teachers, i.e., to involve all curricular components in the project to be addressed. However, there are essentially interdisciplinary themes that do not require the inclusion of all disciplines for their treatment, and the interrelationship of only some of them is sufficient for the questions around the object to be answered satisfactorily. This attempt to include all disciplines in a project causes the result pointed out by Fazenda (2006) – it is a multidisciplinary, fragmented, and not interdisciplinary approach.

At this point, considering the difficulty in working in an interdisciplinary way in schools, especially considering the tradition of the disciplinary paradigm of curricula resulting from the hegemony of traditional theories that influence the organisation of most curriculum programmes (Silva, 2007), we want to explain our position, as researchers, in the face of the counterpoint we made previously. When we affirm that a more open, non-prescriptive proposal for weak classification and framing brings disadvantages, we do not want to fully defend prescriptive curricula. On the contrary, we want to point out that the work with an interdisciplinary approach in Brazilian public schools depends mainly on a formative and reflective dimension, a previous and necessary condition for it to be effective.

We considered, once again, the importance of the field of teacher education as a determinant of the roles that the discourse of interdisciplinarity has taken and can take in the curricula and teachers' pedagogical practices, constituting itself as one of the current challenges of this field of research. We have a long way ahead of us about interdisciplinarity and its facets, as it requires a dynamic that teachers, in most cases, are not used to.

> *At the beginning of the training in interdisciplinary groups, the teachers found it very weird, because they had been having their training only among mathematics teachers for a year doing, and when you mix them, you take the person out of their comfort, because in mathematics they dominate, they know what to address, how to do it, but we proposed to talk about interdisciplinarity in training, and how mathematics participates in it, so we had to bring them together. We took the*

[1]The Special Action Project [Projeto Especial de Ação - PEA] is a training and work instrument prepared by the Educational Units that expresses the priorities established in the Political Pedagogical Project and that aim to qualify the teaching practice. It establishes formative and pedagogical action goals for each school year.

> *mathematics teachers, and the others too, of course, from the comfort zone, because there was no recipe for how to do it and they had to think about it together*. (Cleide – mathematics educator)

The speech of Professor Cleide shows us how a dialogic proposal of formation about interdisciplinarity can cause some discomfort or strangeness among teachers, since it involves discussion with other areas and other contents that are not given but that must be built together. The discourse of interdisciplinarity changes the relations of power and control present in the curricula and the organisation of the schools.

Nogueira (2004) argues that part of the discomfort is because the teachers lack the courage to declare their 'non-knowledge' and fear being labelled as ignorant in a specific subject, fear in the face of the unknown. Hence, they prefer to opt for the convenience of disciplinary work. The work shared with the other presupposes humility and political-pedagogical will to do so.

Thinking about interdisciplinary pedagogical actions means reviewing, rethinking, and changing the relations of power and control present in the curricular discourses, in the hegemony around some disciplines and in the consolidated practices that unfold within the schools. In other words, dealing with the issue of interdisciplinarity means breaking with the disciplinary logic and, therefore, presupposes a dialogic relationship – between disciplines, but essentially between teachers from different areas and between them and their students.

> Interdisciplinarity is the result of students' and teachers' experiences from learning created in the dialogue of and in school. Therefore, it is not only a theory or something realised by interdisciplinary discourse, but by the practice of dialogue. [...] Its result is the formation of the interdisciplinary thinking (São Paulo, 2016, p. 20).

We adopt the Freirean perspective for dialogue as "the encounter between subjects, mediated by the world and that happens in order to name and problematise the world for intervention and transformation" (São Paulo, 2016, p. 53). Therefore, it goes far beyond the simple act of speaking and listening. "Dialogue is thus an existential need" (Freire, 1996, p. 42).

The interdisciplinary attitude Fazenda (2001) advocates should be the engine that enables interaction not only between disciplines but between

people. The interdisciplinary perspective must have the potential to motivate the teachers of a given school to develop closer interpersonal relationships, to work together and collaboratively.

Contrary to this, teaching has been configured as a solitary profession, in which teachers become accustomed to working alone, little integrated with others. The speech of educator Sofia, described below, corroborates this fact:

> *I notice in this theme that we have something that is still a little problematic at school because we are very used to working alone, we often can't even talk to the colleague in our area. I, for example, in relation to other mathematics teachers, sometimes I don't even know what the other colleague is doing, and it is much more difficult to talk to colleagues from other areas.* (Sofia – mathematics educator)

Dialogue, so necessary to the interdisciplinary approach, is done through constant interaction between people. However, precisely related to the conditions to promote a rapprochement between teachers is the first difficulty pointed out by our research subjects about the dialogue between the different areas. Seeking the reasons for this, they argue that part of this difficulty is due, first, to the work demand imposed on teachers in the dynamics of school life and, at the same time, to the unpreparedness of the management teams to promote moments when teachers meet to organise interdisciplinary proposals:

> *I think that in this aspect, we still need to improve a lot, I can't say if it is the school management, the pedagogical coordinator who needs to prioritise this more, organise those moments, I can't say much, but I still think it is a great challenge because we studied, we took this subject to training, we discussed, we thought about ways to do this, but in practice, there at school, I realise that we are still finding our way, because, in the whirlwind that a school is, with all the demands we have, there is no time left to stop and think about how to work together with another colleague, how to bring topics that can be interdisciplinary.* (Sofia – mathematics trainer)

> *Maybe the school is not yet much prepared, because we even have some study schedules at school, there is the Comprehensive Special Training Day (Jornada Especial Integral de Formação – JEIF), when we meet, but there is so much demand and so much to be discussed, that there is no time*

> *reserved for teachers to plan together, and the greatest difficulty, I think, of working with interdisciplinarity is precisely this, the time that a teacher would have to talk to the other teacher, to prepare activities, to prepare a project, something in this sense, so that they can work together*. (Ana – mathematics teacher)

> *The issue of interdisciplinarity, although we have a cycle called the Interdisciplinary Cycle, in fact, each teacher ends up doing their work alone. The idea itself is great, we studied interdisciplinarity when the Programa Mais Educação was launched, but I note that at school, it is still very difficult to get teachers to talk to do things together. We accumulate [activities], we run to and fro, we barely have time to prepare our own classes, you imagine preparing something with another teacher. I think this is still a great challenge* (Gustavo – mathematics teacher).

The excerpts above show how the planning of interdisciplinary work, according to the research subjects, is still a challenge for teachers. This means that the recontextualisation of the discourse of interdisciplinarity from official texts into pedagogical practice meets practical difficulties and undergoes a process of adaptation as it moves between contexts (Bernstein, 1996).

To the extent that interdisciplinarity, in principle, presupposes a dialogue between peers, this requires time, intentionality, and actions for the interlocution to take place, factors that are often not foreseen in the school organisation.

Sofia drew our attention to the role that the management team, especially the pedagogical coordinator, must play in organising an interdisciplinary proposal for teacher training and providing opportunities for moments (pedagogical meetings, collective schedules, joint activity-time) in which teachers can dialogue and carry out planning together. Her speech demonstrates the difficulty in transposing the interdisciplinarity of the training hours in the Regional Teaching Board or school into the classroom practice because although the subject had been discussed and studied, there was no "time" for teachers to talk.

Corroborating this interpretation, Ana argues that, in her school, "there is no moment reserved for teachers to plan together," although moments of collective work are foreseen in the journey of teachers from the municipal

education of São Paulo for class planning and preparation. We recognise that this organisation varies from school to school and that in many cases, collective moments end up being taken by other demands of the teacher's work, such as assessment tests and work preparation and correction or filling out bureaucratic documents.

For this reason, we argue that this type of pedagogical proposal must be institutionally supported and theoretically subsidised by the central bodies - starting with the Municipal Department of Education and the DRE-, thus moving from documents into the school context to become pedagogical practice. When it comes to a principle present in institutional documents, it is easier to engage and involve the teachers. However, we emphasise that a broad discussion with teachers should accompany this movement (proposing changes as an institutional and curricular principle to recognise them as intellectuals and curriculum producers, involve them in the curricular implementation process, and not impose on them from top to bottom.

We consider that the formation for the conceptual and methodological dimension of interdisciplinarity is fundamental, as already explained in the previous arguments. However, we argue that the teachers' education and reflection on this topic should initially go through epistemological issues: Interdisciplinarity for what? To whom it serves? What subject do we want to form when we advocate an interdisciplinary approach? What school project do we want to implement that considers interdisciplinary perspectives? What is the role of disciplinary knowledge in this discussion? These questions are closely related to the conception of curriculum that we share (Silva, 2007). If we are not convinced, individually and as a professional category, of the relevance of this theme, we will hardly be able to incorporate those principles into our pedagogical practice.

FINAL CONSIDERATIONS

As educators, we know that sometimes the mathematics teacher can work with the contents related to his/her disciplinary field and sometimes he/she can seek integration with other areas of knowledge. In this sense, the Programa Mais Educação São Paulo encouraged teachers to look beyond the curricula of their disciplines and begin looking into the curricula of other areas.

Breaking with the disciplinary paradigm of curricula is a complex and herculean task because the curriculum organised in a fragmented way is a pedagogical device that organises classroom routines and pace within a specific

time (Lopes & Macedo, 2011, p. 136). Bernstein (1996) addresses the issue of the disciplinary curriculum from the perspective of power relations since it is the curriculum that legitimises the disciplines, which are in a constant struggle with their boundaries. There is no doubt that the school curriculum ranks and classifies knowledge.

We argue that in the globalised world we live in, permeated by complex issues, it is no longer possible to be restricted to the borders of an area of knowledge. Despite all the challenges it presents, interdisciplinary work, together with intentionality, has proven to be fundamental for the development of skills necessary to live responsibly and sustainably in the 21st century. Inescapably, we must talk about interdisciplinarity with teachers and students.

Regarding the meanings attributed to interdisciplinarity, we saw that the transposition of what was in the texts of the Programa Mais Educação São Paulo to pedagogical practice collided with issues of different natures, which initially go through the conceptual and methodological dimension of interdisciplinary work. It is thus necessary to invest in a model of teacher education that is also interdisciplinary, without giving up the specificities of each discipline, if we want to change the logic of a fragmented school disconnected from contemporary issues.

Considering the methodological dimension, we saw that, when it is possible to plan and put into practice a work articulated with one or more discipline, the teachers choose to work with integrative projects, which reveals an alternative way to organise school curricula and to break with the grids of watertight and isolated disciplines of the other areas of knowledge.

Finally, we know that the proposal of interdisciplinary pedagogical work is not a novelty for the municipal education of São Paulo. However, we still have a long way to go because, to make it effective, the Municipal Department of Education must encourage and assess the interdisciplinary approach as a curricular policy, closely monitored by the DRE and the pedagogical teams of each school.

AUTHORSHIP CONTRIBUTIONS STATEMENTS

All authors have made significant contributions to the article and assume full responsibility for its content. All those who made contributions to the article were named authors.

STATEMENT OF DATA AVAILABILITY

The data supporting the results of this study will be made available by the corresponding author, WRS, upon reasonable request.

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