

Teacher training in Mathematics Fairs: an opportunity to reflect on the advising process

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Abstract: Throughout the development of the educational product linked to Schroeder (2021), it was possible to move between the three pedagogical moments. In them, the different facets of the Network Movement of the Mathematics were discussed, however, the focus was on the advising process and its contributions to the training of teachers. At the end, interviews were carried out with the participants. The questions are organized into four blocks. Later, the responses were subjected to a Discursive Textual Analysis (DTA), which allowed to identify contributions before, during and after participating in the event. Regarding the experiences before, the epistemological conceptions of the advisers were evidenced. At the time of the event, pedagogical contributions were perceived for the work in the classroom. After the event, contributions related to the registration of activities and evaluation of the work for the following years were perceived.

Keywords: Interdisciplinary. Mathematics Fairs. Three Pedagogical Moments.

Formación docente en Ferias de Matemáticas: oportunidad para reflexionar sobre el proceso de orientación

Resumen: No se deben utilizar citas bibliográficas. A lo largo del desarrollo del producto educativo vinculado a Schroeder (2021) fue posible transitar entre los tres momentos pedagógicos. Se discutieron las diferentes facetas del Movimiento Red de Ferias de Matemáticas, sin embargo, el foco estuvo en el proceso de orientación y sus aportes a la formación docente. Al final del mismo, se realizaron entrevistas a los participantes. Las preguntas están organizadas en cuatro bloques. Después de esta realización, las respuestas fueron sometidas a un Análisis Textual Discursivo (ATD) ya partir de él fue posible identificar aportes a la praxis antes, durante y después de participar del evento. Con respecto a las experiencias anteriores, se evidenciaron las concepciones epistemológicas de los asesores. En el momento del evento se percibieron aportes pedagógicos para el trabajo en el aula. Posterior al evento se percibieron aportes relacionados con el registro de actividades y evaluación de trabajos para los siguientes años.

Palabras clave: Interdisciplinaridad. Ferias de Matemáticas. Tres Momentos Pedagógicos.

Formação de professores em Feiras de Matemática: reflexões sobre o processo de orientação

Resumo: Ao longo do desenvolvimento do produto educacional vinculado a Schroeder (2021), foi possível transitar entre os três momentos pedagógicos. Neles, foram discutidas as diferentes facetas do Movimento em Rede das Feiras de Matemática. No entanto, o foco residiu no processo de orientação e nas contribuições para a formação de professores. Ao final, foram desenvolvidas entrevistas com os participantes. As perguntas organizaram-se em quatro blocos. Posteriormente, as respostas foram submetidas a uma Análise Textual Discursiva (ATD), sendo possível identificar contribuições para a *práxis* antes, durante e depois da participação no evento. No que tange o que foi vivenciado anteriormente, evidenciou-se as concepções epistemológicas dos orientadores. No momento do evento, foram percebidas contribuições pedagógicas para o trabalho em sala de aula. Posteriormente, notou-se cooperações relativas ao registro das atividades e avaliação dos trabalhos para os anos seguintes.

Palavras-chave: Interdisciplinaridade. Feiras de Matemática. Três Momentos Pedagógicos.

1 Introduction

Teacher training, in Brazil, only became a concern after the enactment of the independence (Saviani, 2009). This interest becomes evident at the Mathematics Fairs, which, according to Oliveira, Piehowiak and Zandavalli (2015), are called “Movimento em Rede das Feiras de Matemática” (MRFMat) [Network Movement of Mathematics Fairs]. The first Mathematics Fair took place in 1985, in the city of Blumenau, SC (Floriani & Zermiani, 1985), which, from its organization, was named MRFMat and is currently widespread in several states of the Brazilian territory (Civiero & Santos, 2020).

Throughout its existence, the MRFMat has had several graduate-level studies, such as the one by Schroeder (2021), which contributes to the teacher training process by answering the following question: how do the Fairs add to the articulation between the disciplines, regarding the improvement of the *práxis* of the attending teachers? For that, the development of an educational product was necessary: a continuous training course for the advisers of the works, condensed in an *e-book*.

In this context, the goal of this article arises: to interpret the contributions to the teaching work that the MRFMat provides to the advisers attending the Fairs. For this, the Discursive Textual Analysis (DTA) technique was applied on the transcripts of the statements given in an interview. The DTA was chosen as it is suitable for the qualitative nature, given that “the intention is the understanding” (Moraes, 2003, p. 191) of a set of hypotheses. In the context of this research work, the hypotheses concern the moments when the activities in the MRFMat contributed to the training of the adviser as a teacher.

At the end of this paper, to extrapolate the observations and systematize the results, metatexts connecting the gist of the statements were elaborated, so that the reader understands the meaning that the group's speeches have for the training of teachers who act as advisers at Mathematics Fairs.

2 Methodological paths

The educational product linked to Schroeder (2021) is an *e-book* that gathers the materials used in a continuous training course for teachers who advise works for the Mathematics Fairs, aiming at providing them with the transit between different discipline articulations. The *e-book* follows the methodological organization of the three pedagogical

moments (Delizoicov, Angotti & Pernambuco, 2002).

After the development of the educational product, a short course was held with the participation of seven teachers. At the end, they were invited to answer a survey, which served as a database for analysis. The interviews were recorded and, later, transcribed for the DTA.

To understand the contributions offered by the statements, three courses of action were needed: unitarization, categorization and development of metatexts (Moraes & Galiazzi, 2006). The first action takes place when the researcher is interested in the “constituent units” (Moraes, 2003, p. 191). Thus, “the texts and/or speeches exposed for analysis are edited, fragmented and deconstructed, always based on the researcher's interpretative skills” (Medeiros & Amorim, 2017, p. 255). This course of action sought the essence of each excerpt and demonstrated the authorship of the researcher throughout the way he deconstructs the text in his research, since the reading modes that enable it are diverse (Moraes & Galiazzi, 2006).

In turn, the categorization moment aimed at “building relationships between the basic units” (Moraes, 2003, p. 191). These relationships were built through similarity, so that similar constituent units were grouped to produce broad meanings from the analyzed corpus. However, “categories are not readily available, they qualify as new categories are discovered and reconstructed. In the process of categorizing, different levels of categories or subcategories can be developed” (Medeiros & Amorim, 2017, p. 256). The way in which the categories were created or incorporated was another unique contribution by the researcher responsible for the DTA.

Finally, the development of metatexts took place, with an interest in the “emergence of a renewed understanding” (Moraes, 2003, p. 191). At that moment, we sought to textually express the meaning that each category brings to the *corpus*, articulating their similarities and differences with the remaining texts. “Therefore, analyzing becomes a synonym of building understanding, understanding what is incomplete based on a process that resorts to making the interrelationships between categories explicit” (Medeiros & Amorim, 2017, p. 257). Moraes (2003) states that the DTA develops in an orderly manner, which can also be cyclical, until the expression of the text meanings reaches the depth intended by the researcher.

While interpreting the interviews, the three courses of action were applied as follows: initially, the *corpus* was fragmented into units of meaning for each statement; throughout the speeches of the participants, the contributions of the Fairs to the teachers' *praxis* were organized as before, during and after participating in the events.

According to their similarities, the units of meaning were organized into categories. Contributions related to before the Fair were placed in Category 1, named “Understanding of Mathematics”. During the event, Category 2, which elucidates the contributions, is called “Activity Planning”. Finally, the units of meaning indicating contributions after participation are organized in Category 3, called “Activity Records”.

3 Course application

The first contact took place on February 6th, 2021, starting at 13 h (1 p.m.). At this meeting, the participants and the mediator introduced themselves and stated their involvement with the Fairs. The meeting's initial problematization began with the question: “Mathematics Fairs: What are they? What purpose do they serve? How can one advise? And for whom are they?” Regarding this question, participants - based on their prior knowledge - disagreed. Those who had previously managed an activity had a broader perspective, while those whose experiences were restricted to a single activity — such as assessing or advising — were unable

to extrapolate the other aspects.

At this meeting, the organization and application of knowledge was based on refining the provided answers. The strategy was to show the principles of the Movement and bring the amplitude of the developed activities, presenting the scope of such actions.

In Module 2, developed on February 13th, 2021, the focus was on disciplinary articulations. Thus, the discussion was moved towards the MRFMat with the following problematization: “What is the difference between Applied Mathematics and the interrelationship with other disciplines?” All participants answered that not all Applied Mathematics is an interrelationship with other disciplines. In their opinion, this classification can change according to how the activity takes place, which subjects were involved and the obtained result. Regarding the interrelationships, everyone considered that they can happen in different ways, again depending on the subjects and the context in which they are inserted.

Thus, the organization and application of knowledge flowed quickly. The discussions that came up and the theoretical elements that were brought into them only supported the participants' opinions, in such a way that evidenced, for everyone attending, the differences between the disciplinary articulations and the different way they present themselves in each pedagogical practice.

On February 27th, the participants met to discuss the following question: “How can one tell the defining elements of the disciplinary articulations in works from the ‘Feira Catarinense de Matemática’ (FCMat) [Santa Catarina's Mathematics Fair], in the modality of Applied Mathematics and/or interrelationship with other disciplines?” To further develop this problem, which already had a starting discussion during the previous module, two works from previous FCMat editions were read and discussed, seeking to understand which disciplinary articulation better suits the work and how the advising teacher performed in making it effective. Throughout this module, several elements that put the theoretical provocations from the previous module into practice were discussed.

At the end of the course, in Module 4, the participants applied what they learned from the previous meetings into a project outline. To entice them, elements from the civilizing equation were presented so that they could incorporate the discussions into their work. For that, the participants reflected on the question: “How can one advise a work that is suitable for a certain disciplinary articulation that takes elements of the contemporary civilizing equation into account?”

To simplify the construction of the outline, seven elements were given: i) goal or problem: what limits the situation that will generate the work, while giving indications of the related disciplines; ii) methodology: what are the procedures throughout the work; iii) results: as this is an outline, they will only be hypotheses, assumptions of what we want to achieve/produce; iv) disciplines involved: mention the related curricular components; v) concepts involved: detail what, from each discipline, will be required in the development of the work; vi) disciplinary articulation: based on the elements discussed in Modules 2 and 3 and what was defined in the previous elements, sort the works into one of them; and vii) elements of the civilizing equation: a contemporary variable that is related to happiness and human dignity that permeates the development of the work.

4 Interviews with the participants

The seven teachers were invited to participate in an interview structured in four blocks: form, theoretical-methodological content, additional course provocations, and personal

identification. The work had been approved by the Research Ethics Committee of the Santa Catarina State University with the Certificate of Presentation for Ethical Appreciation (CAAE) 56427016.0.0000.0118.

Only one of them did not accept to participate because of demands at work. All interviews were conducted in a virtual room on *Google Meet* between the 12th and the 26th of March, 2021.

4.1 Category 1: Understanding of Mathematics

This category brings together elements that precede classroom work. The understanding of mathematics brought by the teachers in the interviews revealed their epistemology and, in particular, their relationship with mathematics regarding the Fairs.

For further elucidation of the elements that make up this category, four subcategories were created: Expanded View of the Movement; Professional Improvement; Disciplinary Articulations; and Civilizing Equation, which appear in the speeches of the participants according to Table 1, below:

Table 1: Incidence of Category 1 subcategories in the participants' statements

Category	Participant
Expanded View of the Movement	C1, C2, C3, C4 and C5
Professional Improvement	C3, C4 and C6
Disciplinary Articulations	C1, C2 and C6
Civilizing Equation	C1, C2 and C3

Source: Schroeder (2021, p. 126)

4.1.1 Subcategory 1.1: Expanded View of the Movement

This subcategory explains the contribution of knowing the MRFMat to enhance one's participation. The statements contained here deal with the history of the Movement. Zermiani, Jubini and Souza (2015) point out that more than 400 events have already taken place. As an example, C3, who has extensive experience in the topic, considers:

For being a part for so many years of the MRFMat, the part of the history of the Fairs, their editions, the consulting of the Fairs' annals, right? That part [...] regarding the module and the readings in Modules 2 and 3, for us to search the works in the annals, it was easier (C3).

In a complementary way, some statements highlighted the importance of knowing the principles of the Movement and its organizational instances to act in and with the Fairs. Thus, this is what C2 says:

I had no idea. Then I got interested and started to see the public aspect and the other guiding principles. I only knew the Mathematics Fairs regarding assessments, but I managed to learn that the Fair is not restricted to the assessment aspect. There are both bureaucratic and other transversal issues that permeate between them all the time (C2).

The understanding of C2 meets the ideas of Oliveira, Piehowiak and Zandavalli (2015), who present this organizational structure, in motion and in network with its participants. In turn, some participants already knew this structure intertwined with the principles of the MRFMat,

as Oliveira and Zermiani (2021, p. 101) highlight, being:

Public aspect: commitment to share works carried out in schools with the community, gratuity and presence of the schools; teacher and student training before, during and after the Fairs; Integration: between extension, teaching and research and between the areas of knowledge; Inclusion from the perspective of human rights: they include subjects of all levels of education, community, the physically and intellectually disabled; Formative, qualitative and collaborative assessment; collective and democratic discussion: constant assemblies, permanent committee and seminars (Oliveira & Zermiani, 2021, p. 101).

These principles are ratified from a collaborative management that has them realize that the MRFFMat is for everyone. Therefore, C1 affirms:

I see the Fairs as a necessary thing, an opportunity for socializing between different areas of knowledge, about mathematics itself, people from different places and teachers as well. I think it's very important. Very interesting because of this socialization. Now I see that there is a whole planning involved before the day of the Fairs and even after them (C1).

This statement is associated with the essence of a Fair, as highlighted by Oliveira and Santos (2017) when considering the event as a space for sharing practices. Complementarily, C2 also broadened her perspective about the MRFFMat:

When I stop to think, now I stop to think about a more global issue. Before, I had a very particular view, very restricted, actually. Before, when I talked about assessment, for me, it was all about the act of assessing, today I see that it has a much greater aspect than it appears at first. Which is something that is transversal, which has the previous organization, other collections, the advising. Anyway, there are other guiding principles that I had no idea about. Today, this knowledge about the Network of Mathematics Fair has added a lot to this issue. Also these articulations, I had no idea about them and I added them with the course (C2).

The understanding evidenced in this speech brings the Mathematics Fair closer to Mathematics Education, a possibility also discussed by Oliveira and Zermiani (2021) when relating the trajectories of these two movements in Santa Catarina. Furthermore, some speeches emphasize the importance of the assessment for the teacher and for the students, which agrees with studies by Civiero, Possamai and Andrade Filho (2015). As an example, C4 states:

The part that I already knew before the course was the assessment because I was already aware from other courses that I had already attended. But I see that this one we did is different from the others I participated, because they were like this: you can't go up to the student and say you are an evaluator and pitch him a lot of questions (C4).

In general, this category evidenced the understanding of the participants about the MRFFMat. The aspects in which the participants have greater participation and, consequently, greater knowledge (as in the cases of assessment and advising) were widely cited, which showed deep knowledge of the group.

However, the organizational structures, such as the organizational instances, as they are not part of the participants' routine activities, were little explored. The simplified view of those aspects is not a limitation, but a potentiality of the participants, since they can broaden their involvement with the MRFFMat when working at these places in the future.

4.1.2 Subcategory 1.2: Professional Improvement

The excerpts in this subcategory refer to the professional characteristics of the subjects who participate in the MRFFMat and are resignified throughout their participation. C3 noted the long-term personal and professional growth of students and teachers in the Movement:

Every mathematics teacher should go through this experience, because, in my view, it is enriching. You learn, even if you think you are there working with high school, many times you learn a trick to work with the operations with the little ones in kindergarten or early years. That is, you always bring some background. It's repetitive, boring and exhausting to stay two, three days away from home sleeping on the floor of the room [...]. But the background is great, the knowledge you bring is valid, indeed. It's worth for the teacher and even more for the student, right. It is a way for them to socialize, interact with other people, show their knowledge in a different way and I think this is really worth it for the knowledge and the study of mathematics as a whole. Inside the context of socialization and this interaction between the environment where the student is and the environment where the Fair takes place, the space where it takes place (C3).

Valuing personal and professional aspects, especially related to orality, writing and the knowledge of other cultures from participating in the Fairs, is also found in Schroeder, Cucco and Scheller (2017a). For C4, the main highlight is the role of the teacher as an adviser, and the students being protagonists of the developed project:

The Mathematics Fair is literally a movement, a moment, an action through which we exchange experience. It is a very rich moment of information. And I think this shouldn't happen just once a year. I think everyone should have access and that people still can't understand what Mathematics Fairs are. It is a very rich information environment and it shows that mathematics is not that thing, that monster, and that we can do countless things. That we can teach it through different ways. For the Movement, it's showing that it doesn't have to be so difficult, so bad, it can be easier and we can work in a happier, different way (C4).

C4's statement strengthens advising as a process, since, as Oliveira and Dallmann (2004, p. 88) affirm, “it is characterized by involving the student in learning and researching, building and rebuilding concepts. As a process, the advising teacher plays the role of a mediator, facilitator and questioner”.

Thus, in the previous excerpt, the authorship that the students have on the work is also worth of highlighting, which makes the teacher a supporting actor in the process. With the protagonism, Schroeder, Cucco and Scheller (2017b) defend that the students take a position of active actors in the Movement and understand the other dimensions of the Fairs' contributions, beyond the mathematical knowledge.

In C6's speech, a new element of participation emerges: the sharing aspect. He states:

I prepare for the practice, there at the Fair for the presentation of the students. When you stop and write and you see yourself as an adviser and having to do the theoretical part of the Fair. It's very difficult for me because I lack words, I'm not good at Portuguese and I don't read much. I realized that I am going to totally change my way of seeing, of writing, of looking at the Mathematics Fair now (C6).

This speech brings a specific view on the contributions of the event to the students, but it is still valuable, since the communication with the public of the works is one of the aspects of the MRFFMat. However, it must not be the only one. Structuring the presentation is a way of participating in the Fairs, that is, it is part of the advising process, it does not start or end in itself.

In this subcategory, the answers were very specific, as the subjects expressed how the MRFMat contributed to their works. However, due to the similarity between some statements, it is possible to understand that similar collaborations occur with other teachers who have similar histories. Furthermore, these speeches serve as a driving force for new teachers to enter the Movement and seek to add similar experiences to their training.

4.1.3 Subcategory 1.3: Disciplinary Articulations

In this subcategory, the contributions that differentiate the disciplinary articulations for the understanding of Mathematics as a science were gathered. Searching the central goals of the Mathematics Fair, the disciplinary articulations show up in documents in the following way: “raise interest for the integrated teaching of mathematics and other areas of knowledge [...]” (Floriani & Zermiani, 1985, p. 2); and “integrate fresh knowledge and new information and communication technologies into the processes of teaching and learning” (Bylaws, 2020, p. 501). In those goals, there's space for uni, pluri, inter and transdisciplinarity based on the delimitations brought by Nicolescu (1999), Japiassu (1976), Alencar Filho (1997) and Tavares (2015). Regarding the concepts behind each of them, C1 conceives them as follows:

Unidisciplinarity stays only in the area of mathematics; pluri, I understand that it is about a theme, a subject, but each discipline studies it differently and there is no common goal. Inter has a theme, in more than one discipline you have the same study goal for that work and transdisciplinarity goes beyond the disciplines (C1).

In turn, when commenting on the same concepts, C2 remembered the diagrams from the material in Module 2 from the educational product (Schroeder, 2021), presented as an *e-book*:

When we talk about uni, they will be in only one discipline, then we will transit only in the discipline of mathematics. Now, pluri will take those arrows and move into other disciplines. They will not communicate, which happens in inter, there the arrows come and go, while in pluri that does not happen. And trans is something more global, when you take political and social matters and that civilizing equation. I believe it is when you take something, as the name says, transversal, it allows you to use them all at the same time (C2).

In a dialogical process during the course, C3 brought, in his answer, how he perceives, in his practice, the development of each disciplinary articulation:

I was always very intrigued by this issue of transdisciplinarity, pluridisciplinarity and interdisciplinarity. I never really got to work with unidisciplinarity. [...] Now, inter, trans and pluri, I always thought I was inserting chemistry, physics, history, geography, Portuguese, art, I did a lot of work relating geometry in art, but they didn't happen in the interdisciplinary way I imagined they were happening. This opened a lot with this brief study. That's why I think I still need to read a lot more, but it already opened up a lot for me (C3).

Unlike C1, C2 and C3, subject C4 acknowledged that, before the course, all articulations seemed alike, but, throughout the modules, he/she understood the characteristic elements of each:

There are some articulations with very large differences and some that have us think a little more. But when we are working there and after we study and manage to define that we know what each thing is, we manage to define each thing. So, this material we want to work in a pluri way, so I'm going to do it this way. Sometimes we end up doing the way we believe to be easier, but when you use these articulations it

ends up becoming easier. Like it or not, it ends up becoming easier. It's a broader way for the student to see. The moment when you presented the articulations and we saw the difference between each one of them was the apex of the course. I was really amazed (C4).

Like C3, who, in practice, developed activities that he/she classified under another name before the course, C6 realized that all the practices developed in the mathematics classes are unidisciplinary, as they are restricted to the subject:

We work much more with the uni than with any other. We call it inter, but it's uni. And that happens because we work more with the uni, especially for the Fair. I was not aware of unidisciplinarity, I didn't even know it existed, the other ones I had studied before, I had read about them, but I was not aware of the uni. For me it wasn't there, it wasn't part of the articulations. And actually, after seeing and learning all that, I saw that it is the one I use the most (C6).

Finally, C7 considered that the curricular components and the way they are involved in the work determine the applied disciplinary articulation. In her words:

I know uni is just one thing, I know pluri will engage with other ones. That made an impression on me. Like you say, we use it all the time, but we don't realize we are using it (C7).

Complementarily, Tavares (2015, p. 61) considers that unidisciplinarity “evokes an important pedagogical aspect, but it can be dangerous, as it limits one teaching subject, when isolated”. D'Ambrosio (2011, p. 11) considers that pluridisciplinarity “seeks to join the obtained results through the disciplinary approach to deal with more complex situations”. Interdisciplinarity “is about what is, at the same time, between the disciplines, through the different disciplines and beyond any discipline” (Nicolescu, 1999, p. 22). In turn, “transdisciplinarity leads to awareness of the essentiality of the others and of the insertion into the social, natural, planetary and cosmic reality” (D'Ambrosio, 2011, p. 10).

The answers indicate that the participants understood the existence of disciplinary articulations, their applicability and the elements that must be observed in the references for the study of these concepts in the course. This understanding revealed differences and provoked different planning structures from the participants throughout their classes.

4.1.4 Subcategory 1.4: Civilizing Equation

Another aspect that stood out in the interviews and which contributes to the understanding of Mathematics for the participants was the understanding of the civilizing equation. C2 and C3 highlighted the absence of in-depth discussions on the topic:

There it appears quickly in the prelude, there it is shown in materials and video. But I think it could have gone a little further. It's not that I didn't understand, I get what it is, I read the recommended materials, but we could have talked longer about it because I thought it was very important (C2).

That item that is there, really new, is not actually new. We used to work with it as transversal topics in the national curricular guidelines and now it appears with a new aspect in the National Common Core Curriculum, but it needs to be further studied so that it can really happen in the relationship between your scientific concept and this application of contemporary matters (C3).

Complementarily, C1, C2 and C3 considered that the civilizing equation is the element that most needs deepening in future versions of the course. This statement by C2 summarizes

the opinions of the three interviewees:

I didn't mean it was weak, there's no criticism, but it could have been approached further. I understood why you put the video, attached the material, but it lacked authorship. I didn't fail at any moment, as I said, it was nice and smooth (C2).

This absence may be linked to the fact that the discussion about the term *civilizing equation* is recent, based on Bazzo (2015, 2016) and Civiero and Bazzo (2020). The self-criticism of the interviewees regarding the lack of knowledge on the subject shows its pertinence. Thus, the participants showed little knowledge, but, on the other hand, a lot of interest about the subject, concerned with the emerging issues in the delimitation of variables in the equation. The course was able to entice curiosity in the participants, meeting the goal of discussion in the teacher training process.

Throughout the module, the group understood that the possibilities are diverse and transcend any areas of knowledge. However, based on what the participants demonstrated, it would be interesting for the discussions to be more detailed, so that they could study some variables to discuss the presence of mathematics in certain contexts. However, the course length was not enough, given that its purpose was to present and provoke discussion and interest in the topic, which was done from the development of the project outline.

The desire to learn more about the debated subject can serve as a driving force for the assembly, in the future, of a study group on Fairs, with teachers from the Ituporanga region, in addition to placing the Civilizing Equation at the center of the discussions.

4.2 Category 2: Activity Planning

This category brings contributions that the MRFMat provides to the teachers in their pedagogical work. Indeed, three subcategories were created: Disciplinary Articulation Models; Work Organization; and Planning of Disciplinary Articulations, as shown in Table 2:

Table 2: Incidence of Category 2 subcategories in the statements of participants

Category	Participant
Disciplinary Articulation Models	C1, C2, C3, C4, C6 and C7
Work Organization	C1, C3, C4, C6 and C7
Planning of Disciplinary Articulations	C1, C2, C4, C6 and C7

Source: Schroeder (2021, p. 133)

4.2.1 Subcategory 2.1: Disciplinary Articulation Models

In this set of statements, contributions emerge that express ways of applying disciplinary articulations in mathematics classes. In her words, C3 says:

[...] the part where we studied the articulations, right, which started in module three and moved into module four, it changed my way of thinking about the works (C3).

Complementarily, C1 points out that Fairs and disciplinary articulations are inseparable:

I think that all these elements are possible within Fairs. I think all the articulations are possible. The uni is easier to take to the Fair, since it's easier to work with, in my opinion. They can all be accomplished

(C1).

C2 argues that the teacher can choose the best way to carry his work, but some articulations are possible and necessary:

It doesn't matter which articulation you adopt, as long as you adopt one. Sometimes the teachers can't tell, sometimes they don't have the knowledge and in others they have some weaknesses, they can't tell what each one is, but the Fairs are there to clarify that. If you are going to present a work, if you are concise and aware of what you are talking about, for whom is there. The teacher with no authorship of the work, from the moment he listens to my work, he can take this to his classes in the future (C2).

There is an effort to have the advising process happen in a dialogical way with the students and not just as a choice of the teacher. In the dialogical process, teachers and students are authors in a process of *dodiscence* (Freire, 1996), in which the relationship of trust is established. The advising process is explicit in C3's statement:

You develop the work and things emerge. It depends on how much the student wants to research, but it also depends on how much the teacher wants to entice them. But, at first, I think it has to come up spontaneously during the work. You pitch the idea. Or the student brings it and you, as a mediator, entice them, right? The student researches and it just happens, then they begin to realize that this bridges with one or another area of knowledge and they connect them as blades of a fan. [...] But when it arises spontaneously, within the work, I think you can notice the articulations (C3).

Beyond the advising process, C3's statement makes it clear that the disciplinary articulations emerge during the teaching-learning process. With a different perspective, C4 considers that the disciplinary articulations are conducting lines for the development of the works, as his/her statement shows:

I see that these articulations end up helping the teacher. From my point of view, because from the moment you want to work on a specific content you will always, of course, look for the best way to present the content, to present the activity to the student. The Mathematics Fair is there and I see it as a door to show that using these articulations I believe it will be much easier for us to work. I'm not saying all of them, some more, some less. But it is enough for us to understand each one of them and how to work each one. I see that the Fairs are there to show that the articulations are possible and that the teacher knows what he is doing (C4).

C6's position was similar, emphasizing the organizing potential that disciplinary articulations add to the work:

[...] we usually work on a theme, right? And we keep looking, within this theme, for contents [...] so we will bring in other disciplines, not necessarily, I can go further and it will be a very long work. For me to relate within an articulation for the Mathematics Fair, I would have to put it as uni so that I could not expand the work too much and make it tiring. So my point is, relating, I'll look for an articulation, but I don't want the work to be tiring (C6).

Finally, C7's answer considered elements from C2's and C6's statements. C7 considered that the relationship between Fairs and disciplinary articulations depends on the teacher, who makes this choice based on what is more comfortable, either through the work or through teaching experience from previous years. Regarding the choice of themes, the participant added:

When I'm choosing a topic for something, it has to be a very relevant topic today and also a topic about sustainability or something that improves the coexistence of human beings. I think that, with that in mind, I try to apply it within the disciplines that I have more affinity with. It is usually chemistry, physics and biology (C7).

These excerpts highlight that the participants consider Fairs and disciplinary articulations homogeneous elements, however they produce different forms of overlapping.

4.2.2 Subcategory 2.2: Work Organization

This subcategory brings statements that deal with the development of works that are socialized in a Mathematics Fair. Initially, contributions emerge to the role of the adviser as a mediator of knowledge (Oliveira & Dallmann, 2004). In this regard, C1 highlighted three elements: the modality of a work; who the Fairs are for; and the role of writing. She says:

I have to remember to put them right into the modality that they belong. I have to think that the Fair is not just for the students and not just for the teachers and not just for one day. That the writing must be well done, otherwise you can't understand what the work is. I have to clearly define a goal for my work (C1).

As a result of this organization, there are procedures undertaken in the development of each disciplinary articulation. With that in mind, C4 reveals that they will adopt these strategies in their classes:

I will work with this articulation. So I'm going to do my lesson planning, work with the students, using this type of articulation. Most of the time we work and see that this is what happened to me in the work I took. I did the work, I saw that the students were excited. Oh, it worked well, I'll take it to the Fair. I didn't care about the methodology used. After we did the work, after we wrote it, I revisited it to see how I worked, what my methodology was and everything. I think that, in my next one, I want to, let's say, narrow down and work correctly in relation to the articulations (C4).

It is essential that the introduction of a work shared at a Mathematics Fair specify the methodology used and the procedures beyond the lesson plans, as highlighted by C6:

I'm going to look first, it's going to be the first step: articulations. Which one will I work within? I'll get my theme, and within my theme, what can I do? Will I relate to other disciplines? Which? What will they contribute to my work? Based on these studies, whether or not I am going to ask a teacher for help, whether he is going to be there, it will be the question of classification and the way in which I am going to place my work within the other disciplines. It will be within the articulations. This is what I didn't do before (C6).

This category expresses the reasons why advising in the MRFMat collaborates with elements to plan different classes from the traditional ones. The structure presented by the participants coincides with the methodological organizations in some methodological trends¹ for teaching mathematics, including: investigation; modeling; problem solving and games. The development of activities in each work that uses some disciplinary articulation involves the invitation to: study; research; delimit a problem situation; elaborate a set of rules; systematize; validate or create conjectures and elements found in trends.

¹ For a better understanding of the topic, we suggest reading the collection "Trends in Mathematics Education", by Autêntica.

4.2.3 Subcategory 2.3: Planning of Disciplinary Articulations

The contribution to the teacher training of those involved, regarding the planning of an articulation, is contained in this subcategory. C1 considered that planning is the main legacy of the course and, consequently, of the Fairs. For her, there is a need to

[...] have a goal, focus on it and see what you want with that class. And also about the articulations, think something outside the box. Until today I only worked unidisciplinarily. We can end up bringing in contemporary themes (C1).

In turn, C2 brought a broader dimension of the contributions to teacher training. He highlighted the need for teachers to continue learning to articulate their disciplines:

when you have questions, you have to go after it and try to read and discern what it means [...]. We transpose this for the teaching practice for when you are going to present some content, some articulation that you have in mind, you have to really know what that means. If you take it to a fair unaware of what it is in practice you will embarrass yourself, you will not know what you are doing (C2).

C3, even with experience in advising, highlighted that the course contributed for him to more carefully advise his students' projects, especially regarding the defining elements of articulations: goal, methodology and results. For her, it is necessary

[...] to see what the goal of that project is. Properly choose the methodology you are going to work on in this project and define your final product. I think these three points are very important and they need to be linked and that, for me, makes all the difference in the classroom and it was things like that that I didn't always do. Now I think this course shook things up. We get stuck in a rut, it becomes so commonplace that you end up running over things, you want to start from the final product, you forget you have a goal and a methodology that leads you there (C3).

In the same provocative sense, C4 highlighted that, after the course, she felt inspired to carry out a work articulated with another discipline:

This course gave me the courage to look at a project that I am going to do with a different perspective, I am up to it. I am going to do it. I left the comfort zone. As much as I don't like to stay in the comfort zone, may I, every year, I take a risk with something new. This year is going to be different for me, I will take more risks than in previous years. [...] With this course we see that we can always do more (C4).

In the cases of C6 and C7, the contributions were similar. Both highlighted the relevance of planning activities that relate mathematics to other disciplines. In this regard, C6 points out that

The thing of bringing more practical content into the classroom and then you realize what you are working on. I like to work a lot on contextualization. For me, there has to be a story behind the beginning of content. There has to be one reason for the content to be there. [...] I don't necessarily need to have the other teacher working too, and that I can also ask other teachers, I can do a little collective project, but I can also work alone in my discipline and I won't be wrong (C6).

C7 admitted that, from now on, he will “Give the students a slightly different perspective”. Besides, he highlighted the learning of the different ways of relating the disciplines:

How to engage your own discipline and its content within other disciplines. Of course, there will be that content that will be more difficult for you to relate to others, but most of the time try to pass it on to the students... create a relationship with the other disciplines. [...] Try to do that too, as I work in a public school, with it. I think it would be richer because maybe a question they see in some disciplines they can have the answer in another. Or they might have worked with it, it makes the life of the student easier (C7).

From the participants' point of view, the Fairs collaborate in the planning of didactic-pedagogical activities throughout the school year. Furthermore, these events provide ideas and models that can be used in the organization of activities, given that many works are read, watched and evaluated during the Fair.

Thus, in addition to being a valuable moment for students in the exhibition and oral communication of their works, the day of the Fair is important for advisers to find inspiration for the preparation of their classes during the remainder of the school year. Examples along these lines can be found in the "Sociedade Brasileira de Educação Matemática" (SBEM/SC) [Brazilian Society for Mathematics Education] (2020).

4.3 Category 3: Activity Records

After carrying out any work at the Fairs, there are contributions for the teachers who participate in the course. Among them, the writing of the abstract and oral and scientific communications stand out. The subcategories outlined were three: Research, Assessment and Writing, according to the incidence shown in Table 3:

Table 3: Incidence of Category 3 subcategories in the speeches of participants

Category	Participant
Research	C1
Assessment	C1, C4, C6 and C7
Writing	C1 and C7

Source: Schroeder (2021, p. 138)

4.3.1 Subcategory 3.1: Research

This subcategory shows the statements dealing with questions raised after the events were held. C1's suggestion is that the scientific communication of the work should be addressed:

I think it could offer more about research. It was fine like that, but to give you a suggestion I think something about research would be good (C1).

Observing the Fairs that she participated in, the author of this research identified that most of the works presented are linked to Basic Education and carried out with students from public schools. These students having contact with carrying out research and works at Fairs is extremely relevant due to the potential for them to develop an initiation to the scientific and investigative spirit. The relationship between these events and scientific initiation is discussed in Oliveira (2017).

4.3.2 Subcategory 3.2: Assessment

In the opinions of C4, C6 and C7, the care with the assessment on the day of the event contributes to the training of advisers. C4 says:

We could have talked about how to assess properly. Not judging the student too much. I know that this was not the focus of your work, but I think we should train teachers to assess (C4).

It is a part like this where we have to study the assessment criteria. What to use? What to assess? How to assess? It is what we are most afraid of when assessing a work (C6).

C7's concern refers to the sense of making the principle of formative collaborative qualitative assessment manifest throughout the event. For her, it would be interesting to have addressed:

How we should have the assessment assumption. It's always a question. Each one does it in a different way, but it always seems that something is missing (C7).

These suggestions show the concern of all participants with the advising process beyond the materialization of a pedagogical activity and its subsequent presentation at the Fair. Everyone understands advising with a broader dimension, which is in line with the principle of assessing the event, as defended by Civiero, Possamai and Andrade Filho (2015), Oliveira, Civiero and Guerra (2019) and Oliveira and Zermiani (2021).

4.3.3 Subcategory 3.3: Writing

This subcategory expresses activities related to the description of activities developed in the classroom. One statement recalled the changes that the way of socializing in writing went through:

When I started, it was that simple abstract, it wasn't even the extended one, and then it became the extended abstract and today it's not even an abstract anymore, it's an experience report (C7).

These changes are due to the efforts of the scientific committee to qualify the event. Recognizing these efforts, C7 highlighted the importance of scientific communication:

Next time I write an abstract I'm going to focus more on the things I learned here in the course, the goal, that workflow you gave us there. It's just that we used to write before, but in a more random way. So I think it's important now, from my point of view, I'm going to stick to that workflow. I think it makes it easier with the workflow to give to the students when they build their project (C7).

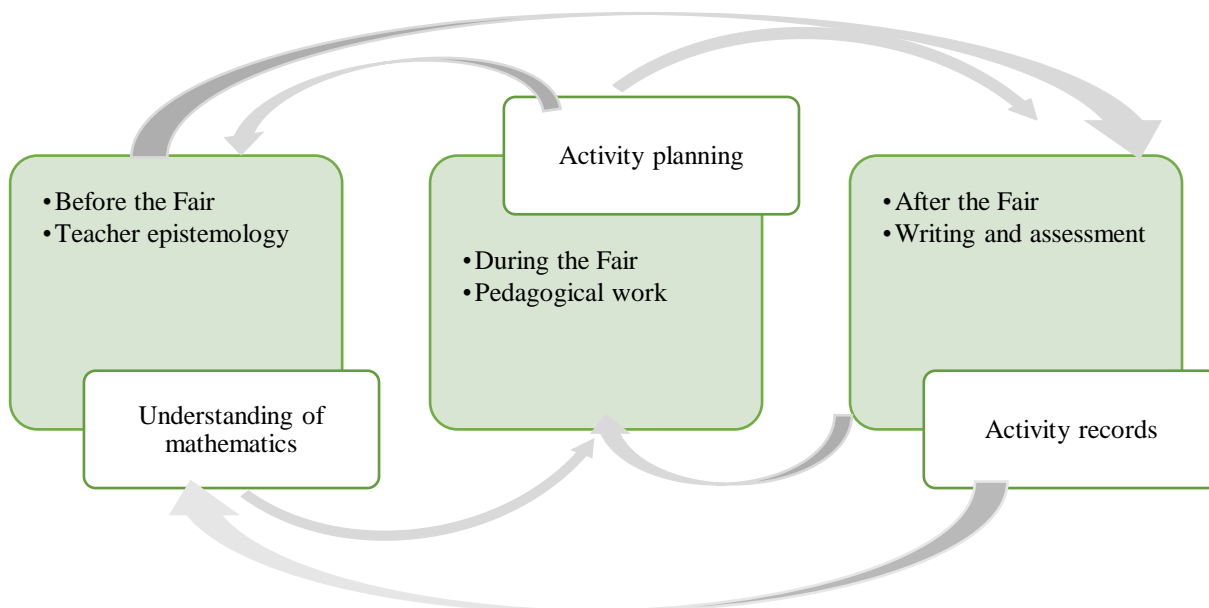
These statements corroborate the need to maintain these records and strengthen the importance of the committee for the formative character that the Fairs have for the participating advisers, as Siewert, Marcuzzo and Ribeiro (2015) defend.

5 Final considerations

This paper interprets the contributions to the work of teachers who participate in the MRFMat. For this, the data collected during the application of the educational product linked to Schroeder (2021) were used. Through this path, it was noticeable that, during the interviews, three key aspects were outlined for the contribution to the *praxis*, as illustrated in Figure 1: the "before", the "during" and the "after" the day of the Fair. From the "before", the category "Understanding Mathematics" was created, which helps to understand mathematics as a science and its role in contemporary society. The "during" was explored through the contributions from the "Activity Planning" category, in which the teacher's daily work creating and applying activities in the classroom was further explored. The "after" was made explicit through the

statements in the “Activity Records” category, which brought together the ways that teachers organize, in writing, what was involved and/or developed in the elements from the previous categories.

Figure 1: Contribution categories of Mathematics Fairs for the professional training of advisers



Source: Own Elaboration (2022)

Carrying out this analytical process was only made possible because of the elaboration and validation of the educational product: the *e-book* with the teaching materials used in the training course for advising in Mathematics Fairs. It addresses the topics that made the data collection possible, creating a favorable environment to understand and identify contributions to the *praxis* of the teachers.

As a perspective of continuity, these contributions can be analyzed and expanded, so that other subjects who participate in the MRFMat may feel motivated to apply the course in an *e-book* format, as mentioned throughout the article, and thus resignify the results identified throughout this text.

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