

Initial teacher training and the thematic approach: the process of curricular reorientation in PIBID/Physics at UFSM⁺*

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Abstract

Physics teaching in Brazil has been characterized as abstract and of little significance to students, often reinforced by transmissive and purely conceptual teaching. To overcome this scenario, it is necessary to train critical teachers who are capable of "sowing" a non-propaedeutic approach to teaching physics that relates to the reality of students' lives. Many authors and researchers rely on the Thematic Approach to achieve teaching that meets the needs of students. This approach, supported by Paulo Freire, defends the theme as central to teaching and strongly related to the reality of students. One way to work with this approach is through the Three Pedagogical Moments as a curriculum structuring framework. The PIBID subproject for the Physics Degree at UFSM, developed from 2022 to 2024, was organized so that participants could build knowledge about the Thematic Approach and the Three Pedagogical Moments and implement these perspectives in schools. Considering this, the research question is: How does the experience of a curriculum reorientation process from the perspective of the Thematic Approach influence the initial formation of PIBID participants in the UFSM physics course? Through Discursive Textual Analysis, four categories were identified: Dialogue, Problematization, and the Generating Theme; Collective and Co-learning; Process, Development, and Overcoming Challenges; and Teacher Transformation and A New Educational Purpose. The discussion of the categories found that PIBID/Physics 2022

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enabled a formation in line with the search for problematizing and dialogical “praxis”, inspired by the construction of curricula based on Generating Themes, collective work, and, through a rigorous and empathic process, the reconstruction of PIBID participants seeking “to be more” and conceiving new purposes for teaching.

Keywords: *PIBID; Thematic Approach; Physics Teaching; Three Pedagogical Moments.*

I. Introduction

Initial training in undergraduate courses has been a topic of great importance in the field of education. Questions about the training of future teachers and their relationships with schools and educational policies are constant, keeping research on this topic always relevant. The teaching of Science, and specifically the teaching of Physics, is no different, with thematic lines dealing with the training of Physics teachers in the main events and journals in the field.

Historically, it was only with Law 5.692/71 that teacher training at the higher education level began to be considered, in degree courses to work in the final four years of elementary school and high school. At the time, there were short degrees, which were only accepted for teaching in the final years of what was then known as junior high school, and full degrees for teaching in what was then known as high school. Subsequently, the LDB (Law of Guidelines and Bases for National Education) of 1996 made teacher training in full degree courses necessary for working in basic education, except for the normal high school course, which is still valid as a teacher training course for working in Early Childhood Education and in the early years of Elementary School.

The need for research on teacher education is justified by the complexity of teaching work, considering the imperfections in Brazilian education and the constant changes that this education undergoes every year, and with each change of government. This work, which is never limited to simply “teaching classes”, is permeated with situations and actions that require a less passive role from the teacher, as Silva (2023) argues.

Teacher training is advocated in the form of initial degree courses, which enable the training of teachers who build curricula capable of overcoming the culture present in society and in legislation, which conceives the role of the teacher as a mere reproducer of proposals. This training is provided to give the desired autonomy in developing their curriculum, reflecting the reality of the school, to achieve the desired education, as described by Muenchen (2006).

Thus, it is assumed that members of the school community and local community have autonomy in developing the curriculum. Therefore, initial training is needed to promote this autonomy in curriculum development.

For Giroux (1997), teachers should act as intellectuals and create the necessary conditions for writing, researching, and working collectively in the construction of the

curriculum. Expanding this vision of identity, based on Freire's assumptions, it is understood that the construction of the school curriculum should involve all members of the school and the local community. Training that treats teachers as builders of the school curriculum, capable of articulating a collective construction of this curriculum, to affirm the identity of their practice, the school, and the community, is what is sought when defending the Freirean Thematic Approach (FTA) present in the initial training of teacher candidates. It should be noted that among the concepts of teacher training, the one that considers the unfinished nature of the individual and the constant search for self-improvement for the training of educators is defended, that is, in this concept, the teacher is constantly forming and being formed, according to Freire (1996).

Aiming to understand the relationships between FTA and the initial training of educators within PIBID, in the specific context of PIBID/Physics 2022, the central problem of this study is: *"How does the experience of a curricular reorientation process from the perspective of the Thematic Approach influence the initial training of PIBID students in the physics course at UFSM?"*.

The relevance of this research is supported by the frequent and constant need for studies on teacher training, so that there is always discussion about the type of educators desired in Brazilian schools, the potential that the Thematic Approach (TA), especially the FTA, has to improve the training processes of educators and the relevance of research that discusses the TA within the PIBID subprojects.

Adding to this justification, a literature review was conducted within the dissertation related to this article,² which sought to analyze the two main events in the field of Physics Education, the National Symposium on Physics Education (SNEF) and the Meeting on Research in Physics Teaching (EPEF), covering works from 2007 to 2022 - a period chosen due to the start of PIBID in Brazil. Only works that included "Thematic Approach" and "PIBID" in their text were considered. This analysis had a corpus of 11 works that related the two required terms. The "shallow" quantity of works showed the incipience of projects such as the object of this article, highlighting the relevance of this study.

In summary, the review showed that the studies, even though they emphasized the importance of the local context as central to training, did little to explore the interdisciplinary potential arising from this context, using interdisciplinarity as a reference, but not delving deeper into this discussion in their work. It also clarified that articulations with Freire's perspective are possible and have the potential to promote greater student participation in the classroom, but only two of the studies pointed to the investigation of GT, both from the same PIBID project, and the others deal with Freire's framework as praxis in the classroom, without GT. Furthermore, the studies that discussed the 3PM, did so as a pedagogical practice. Therefore, there was no Study of Reality (SR), which distances these studies from the project

² Dissertation title: The thematic approach in initial teacher training: a look at UFSM's PIBID/Physics (Santos, 2025).

discussed in this article. Based on this review, it was understood that curricular restructuring based on TA and Freire is rare within the contexts of PIBID in physics degree courses, which strengthens the relevance of the study presented.

Therefore, the general objective of the article is to *investigate how the experience of a curriculum reorientation process from the perspective of TA influenced the initial training of PIBISD students in the physics course at UFSM.*

It is important to highlight that the main theoretical framework of this study, in the context of TA, is the FTA approach, which uses the Three Pedagogical Moments (3PM) as curriculum structuring elements (Muenchen; Delizoicov, 2012), with SR as a path to achieve the Generating Theme (GT). To achieve the objective and, consequently, respond to the proposed research problem, this article was organized into five topics: Research Context; Theoretical Framework; Methodology; Results and Discussions; and Some Considerations.

II. Theoretical framework

For many students in basic education, physics has been considered abstract and distant from their world (Lopes, 2004). The culture of physics teaching that does not address students' lives can be reinforced by fragmented, disciplinary teacher training, focused on the mechanical resolution of exercises and not linked to social contexts (Auler, 2007). This training reinforces a transmissive and conceptual approach to teaching physics, in which the teacher is at the center of the teacher-student relationship (Mizukami, 1986). This teaching format is propaedeutic and treats Physics itself as merely a stage or barrier between the subject and its future goals (Auler, 2007).

When considering the transformation of science education and, consequently, physics education, Delizoicov, Angotti, and Pernambuco (2011) propose overcoming this transmissive and merely conceptual teaching through TA. In this approach, the contents originate from the theme, with all concepts and phenomena interconnected by the theme. TA proposes precisely to overcome traditional, fragmented, and propaedeutic teaching, not only in a didactic-pedagogical way, but through processes of curricular reorientation (São Paulo, 1992; Muenchen, 2010; Araújo, 2015). Thus, the rigid division of subjects in educational work fails to contemplate the breadth of the theme, and it becomes necessary to collectively build a curriculum that can cover a theme of real complexity.

Understanding TA from a curricular perspective, three aspects of this approach are highlighted (KLEIN, 2021). These aspects are considered in this research because they corroborate the discussion of the practices that took place in the PIBID Physics program at UFSM, in which the curriculum is built around the theme. These are: TA from the perspective of Education-STS (TA-STS), TA from the Freirean perspective (TAF), and TA in the Freire-STS articulation (TA Freire-STS).

The aspect that deals with the perspective of STS Education works with socio-scientific themes, requires overcoming the myths of Science and Technology (ST) (Auler,

2002) and aims to achieve what has been termed STS purposes, the development of perception, questioning and social commitment, seeking to educate critical citizens, capable of participating in society's decision-making processes (Strieder, 2012; Halmenschlager, 2014). According to Halmenschlager (2014), in this aspect of TA, the nature of the theme can involve several dimensions, especially the social, political, and conceptual dimensions. Furthermore, practices in this aspect have strong links with scientific and technological literacy. FTA, on the other hand, works with GT, which requires a diagnostic process of the local context and uses Freire's praxis, aiming to free subjects from their oppressive realities and enable them to transform that reality (Freire, 1994).

From the perspective of the FTA, GT is a central and indispensable element, identified from the reality experienced by the students through participatory processes of investigating reality, ensuring the link between scientific knowledge and the concrete reality of these subjects (Torres, 2011; 2013; Saul, 2019; Magoga, 2018; 2020). The GT is not a mere accessory, but rather the structuring element of the entire educational process, as it articulates the identification of problems, critical reflection, transformative action, and curriculum planning (Freire, 1994; Delizoicov; Angotti; Pernambuco, 2011; Magoga, 2017). Magoga (2018; 2020) emphasizes that proposals that do not start with the GT cannot be considered ATF, since it is this element that guarantees the critical problematization of extreme situations and the collective construction of knowledge. In the same vein, Saul (2019) points out that, although there are different types of TA, only those based on GT actually fulfill Freire's assumptions. Converging with this view, Torres (2011; 2013) emphasizes that ATF-oriented curricular praxis is only effective through research and thematic reduction, since it is in the GT that principles such as participation, interdisciplinarity, and critical transformation of reality are realized. In short, the presence of GT is an essential condition for ATF, as it ensures that knowledge is constructed in a dialogic, contextualized, and emancipatory manner, as proposed by Freire in his pedagogy of problematizing reality. Thus, it can be said that without GT, there is no ATF, but only thematic practices that do not achieve the pedagogical totality proposed by Paulo Freire.

In this context, the structuring 3PM of curricula described by Muenchen and Delizoicov (2012) constitutes a path toward achieving GT and, consequently, toward implementing ATF. The first moment – the RE – is especially relevant, as it constitutes the stage in which the experiences, problems, and contradictions of the students' context are investigated, creating the conditions for the emergence of the GT. Thus, the RE presents itself as an alternative to Thematic Research, allowing the 3PM to act as a structuring element of critical and problematizing curricula (Centa; Muenchen, 2016). In this way, the articulation between the GT and the 3PM strengthens the coherence of the ATF, ensuring that the educational process is rooted in the reality of the subjects and develops in a dialogical, interdisciplinary, and transformative manner.

The 3PM curriculum structure is defined by Muenchen (2010) as:

a) Reality Study (RS). The reality of the community is problematized through dialogue, using “various techniques and data collection instruments that construct and reconstruct the process.” (São Paulo, 1992). This allows the problem to be revealed, becoming the GT.

b) Knowledge Organization (KO). At this point, the knowledge that will be worked on in the classroom to elucidate the GT, i.e., the planning, must be defined collectively.

c) Knowledge Application (KA). This is when the plans created in the KO are implemented, and the educational process is evaluated, allowing for real-time adjustments to be made according to how the students are progressing with the topic.

Finally, TA Freire-STS, a term explored in depth by Maraschin, Fonseca, and Lindemann (2023), articulates the two perspectives, ATF and AT-STS, working with GT, emerging from the local reality. This was the object of the actions analyzed in the project and in this article. Understanding the overcoming of CT myths and STS purposes as fundamental for the liberation of subjects (Auler, 2011), it aims to train critical citizens capable of participating in decisions in situations involving STS and who can transform their own reality. This integration seeks to train critical and participatory subjects, capable of understanding science and technology as human constructions, inserted in social, political and economic contexts (Maraschin; Fonseca; Lindemann, 2023). Nevertheless, the set of objectives derived from STS Education, when combined with Liberating Education, lead to true social participation (Rosa, 2019; Klein, 2021).

An important concept that connects AT-STS, ATF, and, above all, Freire-STS, is the dialogue of knowledge. As proposed by Auler (2021), it constitutes a possibility for overcoming the hierarchical relationship between science and everyday knowledge, assuming the perspective of an education based on co-production and co-learning. In the author's words, “the dialogue of knowledge [...] implies recognizing that science is not the only legitimate knowledge, but that it must be articulated with others, in collective processes of knowledge production” (Auler, 2021, p. 45). This concept dialogues directly with ATF, since GT emerges from the situations experienced by the subjects and requires the valorization of local knowledge in the educational process (Magoga, 2020; Saul, 2019; Torres, 2013). Similarly, STS Education finds in this principle a basis for democratizing science, enabling critical participation in socio-scientific issues (Auler; Delizoicov, 2015). Thus, the dialogue of knowledge advocated by Auler (2021) presents itself as a fundamental link for strengthening critical, contextualized and emancipatory educational practices.

The complexity of teaching justifies conducting studies that address teacher education. This profession is never limited to “teaching classes”, it is permeated by situations and actions that require teachers to play an active role (Silva, 2023). This advocates for an initial teacher training that enables the formation of curriculum developers capable of overcoming the culture of propaedeutic education and transmissive and conceptual teaching. This training aims to

provide autonomy in the construction of curricula in schools, endorsing the reality of the subjects, to achieve the desired education (Muenchen, 2006; Muenchen; Auler, 2007).

In this way, teachers are defended as creators of their profession, a defense of the identity of educators, for which their participation in the construction of curricula is fundamental. Based on Freire's assumptions, it is understood that the construction of the curriculum should involve all members of the community in which the school resides and for which the school exists. Training that considers teachers as curriculum developers, in order to affirm the identity of their teaching practice, the school, and the community, is what is intended when defending the ATF and AT Freire-STS in the initial training of teachers.

It should be noted that the essential nature of this type of training also exists in the need for a change in curricular culture. This is justified because even if there is a social and political transformation towards a culture of teacher autonomy, if there are no educators capable of acting autonomously in the construction of curricula, the culture of the teacher as executor of proposals may prevail.

III. Research Context

The PIBID subproject for the Physics Degree course at the Federal University of Santa Maria (UFSM)³, carried out from October 2022 to March 2024, is referred to in this article as PIBID/Physics 2022. In addition to the program's own commitments, PIBID/Physics 2022 aimed to go further and achieve objectives aligned with the AT perspective.

Among the objectives of the project were: the production and implementation of didactic-pedagogical activities that would enabled the inclusion of topics in the school context, through a dialogical and problematizing perspective; the development of actions that sought the University-School interaction in the educational context, allowing undergraduate students and supervising teachers to collectively construct and develop didactic-pedagogical activities in the classroom; encouraging undergraduate students to engage with the reality of the public elementary schools in order to broaden the relationship between theory and practice in teaching; valuing partner public schools, through supervising teachers, as co-trainers of future physics teachers, making them protagonists in the initial training processes; making teaching and learning materials available and disseminating them in a free, public digital repository; and producing and disseminating knowledge through the publication of articles in scientific journals and/or academic-scientific events in the field.

In order to meet the general objectives of the program and specific objectives of PIBID/Physics 2022, the training activities for PIBID participants were organized based on the 3PM as a curriculum framework. This process emerged from what was conceived by Paulo Freire in *Pedagogy of the Oppressed*, constituting a reinterpretation of the author's process and,

³ Project registered on the Project Portal of the Federal University of Santa Maria under number 058838. Available at: <https://portal.ufsm.br/projetos/>.

especially, inspired by the Curricular Reorientation Movement of São Paulo, when Paulo Freire was secretary of education and the 3PM perspective guided the entire work process in the Interdisciplinary Project (Torres; Cadiz; Wong, 2002; São Paulo, 1990).

Therefore, according to Muenchen (2010), the structuring 3PM of curricula are understood as: (i) RS, a moment in which a diagnostic investigation of the community to which the school belongs is carried out in order to build a dossier of this reality and find the GT; (ii) OC, based on the GT, the knowledge of specific areas (Ex: Physics, Chemistry, Biology...) is articulated, using the social situations present in the dossier to plan the classes that dealt with the theme found, composing a program; (iii) KA, reserved for the implementation and evaluation of the program built. Here the planned lessons are put into practice and reconsidered based on the experiences and evaluation of this process. It is reiterated that this process comprises concepts from specific areas as a path to something more meaningful within the students' reality (Muenchen, 2010; Muenchen; Delizoicov, 2012).

The PIBID participants were divided into three groups, corresponding to the three schools participating in the project, with each group carrying out the process for its own school. In the RS, the PIBID participants, accompanied by supervising teachers, conducted a diagnostic investigation of the local reality using interviews with the internal and external school community, searches in news reports, visits to the community and to the school, and searches for information in agencies such as IBGE⁴, IPLAN⁵, City Hall and others as data collection tools. The data collected was analyzed using Discursive Textual Analysis (DTA) to build the dossiers and find the GTs.

Next, each group carried out the KO based on the GT from their school. The PIBID participants planned the set of lessons using the information contained in the dossier of the community in which their respective schools are located. Considering this, it is important to highlight that these plans were constructed based on the 3PM as a **pedagogical practice**, which, according to Muenchen and Delizoicov (2014), are: Initial Problematicization, Knowledge Organization, and Application of Knowledge.

Finally, in the KA, these plans were implemented. It should be noted that each of the groups organized the implementation in their own way, in pairs or quartets, carrying out their own plans or those drawn up by their colleagues in the group. These implementations were discussed periodically in the large project group, i.e., with the three groups and their supervising teachers present.

It should also be noted that members of the GEPECiD⁶. They acted as collaborators in the process, conducting workshops on the theoretical aspects of the project and assisting the PIBID participants in the training process. In addition, the PIBID participants produced

⁴ Instituto Brasileiro de Geografia e Estatística (Brazilian Institute of Geography and Statistics).

⁵ Instituto de Planejamento de Santa Maria (Planning Institute of Santa Maria).

⁶ Grupo de Estudos e Pesquisas em Educação em Ciências em Diálogo (Study and Research Group in Science Education in Dialogue).

monthly individual reflective journals, reporting on their experiences throughout the process, and collective reflective journals during the large group meetings.

The organization of PIBID/Physics 2022 was structured in an introductory stage, in order to clarify the proposal for PIBID participants, and in the 3PM as curriculum structures. The project was made possible through readings of the reference material that guided the proposal, workshops, and practices by PIBID participants based on what was discussed in the training meetings, as well as moments of dialogue and reflection. It is worth noting that all activities carried out in training meetings were organized based on the 3PM as a pedagogical practice, so that PIBID participants could also learn about this dynamic through the example of the training they were experiencing.

IV. Methodology

As already mentioned, the research was guided by the search for understanding of the problem: *How does the experience of a curriculum reorientation process from the perspective of the Thematic Approach influence the initial training of PIBID students in the physics course at UFSM?*

The study is exploratory, descriptive, and explanatory in nature, as described by Gil (2022). It is understood as qualitative research, which aims to emphasize meanings, beliefs, and values, according to Silveira and Córdova (2009). As for the type of research, according to Yin (2015), it is a case study in which an investigation is carried out in a specific group (Pibid) and on a specific phenomenon in the context of that group (The Thematic Approach).

Based on Gil (2022), data collection involved analyzing the work of the PIBID participants involved in the project and interviewing them. Data analysis was performed using the Discursive Textual Analysis (DTA) method, following a three-step process: unitarization, categorization, and communication (Moraes; Galiazzi, 2016).

It is important to describe what is understood as a reflective journal, one of the data collection instruments used in the research. The Pedagogical Practice Journal (PPJ) defined by Paniz (2007, p.45), is similar to the journals that were created by the PIBID participants:

[...] a tool in which teachers record their plans followed by comments on their implementation in the classroom, allowing for more focused organization and reflection on what is developed in practical situations.

It should be noted that in the case of PIBID/Physics 2022, journals were written not only about the implementation of their plans, but the entire process – RS, KO and KA – in addition to journals about the workshops and other training sessions held collectively. Specifically, these journals of the training meetings were written collectively, with the PIBID participants writing together with their supervisor and, subsequently, members of the Research Group contributing suggestions.

Finally, interviews were conducted with the PIBID participants. The interviews provided further insight based on the questions that were raised: 1. "What did you learn throughout this process? Could you highlight the most significant aspects?"; 2. "Which elements of the practices carried out in the project do you intend to take with you into teaching in the future?"; 3. "Was there an opportunity for dialogue with other areas of knowledge at school?" and 4. "What were the biggest challenges you faced?".

In order to uphold research ethics, the identities of the subjects involved were omitted, and a consent form was drawn up and duly signed by the subjects. Thus, the project and the consent form were approved and registered by the Human Research Ethics Committee of UFSM (CEP-UFSM) and also registered on the Brazilian Platform.⁷

The results were obtained by selecting units of meaning taken from the Individual Journals (IJ), the Training Meeting Diaries (TMD), and the Semi-Structured Interview Transcripts (SIT). The codes for the units indicate the collection instrument by IJ, TMD or SIT, the unit by UX (with X = 1, 2, 3, ..., n) and, in the case of transcriptions, the participants by PY (with Y = 1, 2, 3, ..., n) forming codes such as DI_U1, DEF_U1 and TES_U1_P1, for example.

This analysis followed the research problem, seeking units of meaning with the potential to answer it. From this, a total of 557 units of meaning were generated, which were related and grouped into four categories. The categories were named as follows: *Dialogue, Problematization, and the Generating Theme* (148 units), *Collective and Co-learning* (125 units), *Process, Development, and Overcoming* (169 units), and *Teaching Transformation and A New Educational Purpose* (205 units).

V. Results and Discussions

V.1 Dialogue, Problematization, and the Generating Theme

This *category* focuses on a discussion of the difficulties and potentialities experienced by PIBID participants in their contact with dialogue, problematization, and the GT. Problematizing and dialogical teaching are challenging, so there were difficulties in terms of problematization and maintaining dialogue in the classroom. Obviously, this was not an easy process; there was an initial resistance from the PIBID participants themselves and from the students to the change from a passive classroom to a classroom in which problematization and dialogue take place, as portrayed in the units:

We're not used to teaching classes like that. Neither are they used to having classes like that, nor are we used to teaching classes like that. So, it was very complicated [...] both for us to try to make

⁷ The project is registered on the Brazil Platform under CAAE 77862224.8.0000.5346.

it work, talking and everything, and for them too, who were very reluctant until they managed to leave. (TES_U59_P6).

But, during the PIBID program, we realized that yes, sometimes we still reverted to traditional methods. [...] We saw all this through how the dialogue was established, right? How the students responded to that, trying [...] to differentiate between what was resistance from the class, and what was the difficulty in understanding the problem [...]. (TES_U218_P20).

Adapting to dialogic action, as required by TA, is a process that takes time, and collective action seems to have helped in the development of this process. Regarding the relationship between dialogue and problematization, we have:

El desafío freiriano es construir nuevos saberes a partir de la situación dialogica que provoca la interacción y la división de mundo diferentes, pero que comparten el sueño y la esperanza de construir juntos nuestro ser más (Streck; Redin; Zitkoski, 2008, p.153). [The Freirian challenge is to construct new knowledge based on the dialogical situation that provokes interaction and division between different worlds, but which share the dream and hope of building our true selves together]. (Streck; Redin; Zitkoski, 2008, p.153).

For the dialogical, problematizing educator-learner, the programmatic content of education is not a gift or an imposition – a set of information to be deposited in learners – but rather the organized, systematized and augmented return to the people of those elements that they have delivered in an unstructured form (Freire, 2005, p. 97).

As can be seen in the excerpts above, the task of questioning and discussing reality, the lived world, is complex, and therefore, training educators capable of questioning, generating dialogue, and maintaining this horizontal relationship in the classroom is not trivial; it takes time, as it is a process. The units in this category demonstrated that by working with GT, developing problematizations, and encouraging dialogue within the training process, the PIBID participants developed a capacity for interdisciplinary practice in the classroom.

It should be noted that interactions with educators from other areas were not possible, which weakens the interdisciplinary potential, but in seeking to cover the entirety of the theme that emerged from reality, they sought to include other disciplines besides physics. As highlighted by the excerpts below:

It manages to connect other areas much more than any other approach [...] For example, we can simply take the topic of waste, which is the generating theme, and connect it with many other things. In physics class, we talked about it, even brought in some topics from other areas of knowledge, and held an interdisciplinary class. [...] We really wanted to have a professional, someone with a degree in geography or biology, to help us with something. [...] We would be able to build more cohesive and in-depth plans, which would probably be more interesting. (TES_U190_P18).

Through the problems, [...] Also, I think this owes a lot to what we saw in the study of reality, right? We realized that physics was no longer something isolated, but that it also depended on other things that were sometimes simply ignored. (TES_U212_P20).

The first excerpt shows that there was a concern to develop interdisciplinary classes and also reveals an awareness that this interdisciplinarity is limited precisely because of the lack of cooperation between educators from different disciplines. Furthermore, the second excerpt clarifies the fact that, when RS meets GT, it does not distinguish between areas or disciplines, so the PIBID participants began to see physics as part of a more complex whole and not isolated from other areas or from concrete reality. According to Sá e Silva (2008):

In pedagogical practice, interdisciplinarity and contextualization feed off each other, since addressing the issues raised by social themes exposes the interrelationships between objects of knowledge, making it impossible to produce contextualized work from a rigid disciplinary perspective.

Therefore, it is not possible to fully cover the GT without collective action by teachers from different disciplines and a focus on addressing the interrelationships exposed by the theme. Even so, the PIBID participants sought to take advantage of the interrelationships between the objects of knowledge to contemplate the theme and develop questions and dialogues that were meaningful to those students.

Finally, the category showed that through a formative, problematizing, and collective process, it was possible for the subjects to become capable of developing the GT in the classroom. They understood the potential of GT to create connections between subjects and between subject and reality, promoting the dialogical environment in the classroom, as reinforced by the excerpt: “*And even more so when we work through the Generating Theme, we get involved, we experience that reality more deeply, you know? We can talk to people*” (TES_U36_P4).

V.2 Collective and Co-learning

There were indications that the internal organization of the groups (collectives) also took place in accordance with FTA. This category elucidates how the organization of the project, as a formative process guided by the 3PM and focused on the FTA, by valuing the collective action of the subjects, enabled co-learning⁸ as a “facilitating device” for the development of future educators.

This movement was in line with what Auler (2021) advocates and describes as the dialogue of knowledge, understood here as the dialogue that occurs within a collective⁹ in

⁸ In this research, co-learning is understood as learning from dialogue and collective work among peers/groups, specifically, among the PIBID participants for the development of FTA.

⁹ Collective, in convergence with what was described by Fleck (2010) for Collective Thought.

pursuit of the same problem, “cultivating” new knowledge in common. In this parallel, we have the PIBID Physics collective composed of Research Group Participants¹⁰, supervising teachers, and the PIBID participants dialoguing to build and implement Physics curricula based on the FTA.

Discussing specifically what happened with the PIBID participants, it is understood that the groups kept their plans subject to change, benefiting from collective work to better structure them and thus building theoretical and practical knowledge of physics teaching with a focus on social participation. The excerpts below highlight this characteristic of PIBID Physics:

In all these contexts there was co-learning, [...] we can never say that we know more or less, because the subject is diverse and reality is diverse, [...] So, as we were developing the material, I certainly learned a lot, ideas, connections that were made that I had not thought of, for example, the girls involving concepts of optics in the identification of trash, I did not know that and it was an idea that came up. (TES_U23_P3).

It has been very enriching to hear colleagues' reports, as I revisit many stages of my academic life in this process. It is inevitable to return to the first time I was on the “other side” in the classroom, where I shared the same feelings of insecurity, fear, enthusiasm and all the others that were shared in the meetings. (DI_U162).

For the training of the PIBID participants, the collective work coordinated by the 3PM, through problematization and dialogue, enhanced teaching activities, with co-learning in favor of lesson development, in favor of the elaboration of practices that were previously unprecedented in their respective contexts and in accordance with FTA. When discussing curriculum development in TA, Silva (2023, p.162) states:

[...] curriculum development based on one of these perspectives needs to start from training spaces, whether in initial training, as argued by Hunsche (2015), or in continuing training processes, as argued in this study, since this roadmap has established that curriculum development in TA takes place collectively through praxiological processes.

The author reinforces the need for training processes for the effective construction of curricula consistent with TA, as well as with FTA, highlighting the importance of the action-reflection-action movement of collective praxis. Even though it was challenging for the PIBID participants to work collectively, once organized, this coordination between future educators leveraged TA in the training process, as highlighted by the following units:

¹⁰ Master's students, doctoral students and doctors who have varied knowledge about TA and FTA.

The important thing is to work together, [...] Working together helps us find connections between units and take them into account when developing lesson plans, so that no subject is repeated or any aspect is overlooked. (DI_U123).

[...] collective work and dialogue are complex. They are rewarding, but they are complex. [...] in the thematic approach, we encompass positioning and criticality. Sometimes people disagree. So, this is one of the issues that was a little complicated until everyone reached a consensus. (TES_U40_P4).

The dialogue took place not only between the PIBID participants and the students, but also among the PIBID participants themselves, which was fundamental for co-learning. As described in the second excerpt above, neither dialogue nor collective work is trivial; peer commitment is necessary to achieve better coordination and better dialogue within the collective, but the reward for this commitment comes in the form of a more reflective teaching practice.

Some of the units in this category indicate that promoting thought-provoking activities and a space for dialogue may have contributed to an effective "exchange" of knowledge and experiences among the project members. Examples can be found in the following excerpts:

This moment of talking about plans. They brought valuable reflections in the sense of learning from each other. The exchange of experiences between the centers led to reflections on how to improve the implementations of all centers. (DEF_U10).

Our project appeared to be the most 'advanced', as it has already carried out more activities, but it is interesting to hear from staff that the strategies adopted to address certain content differently, moving away from traditional teaching, is something that we also do in the project. (DI_U4).

As can be seen in the units, there are indications that this collective learning took place both at the time of the RS and during the KO and KA moments. According to Costa (2022, p. 199):

For true dialogue to exist, we need to value each other's existence and relevance, not acting as absolute holders of knowledge, recognizing that we need each other, that no one exists alone, and that we need the collective contribution to overcome challenges in the quest to 'be more'.

And this is how PIBID/Physics was developed, with equal communication between PIBID participants, supervisors, and Research Group Participants. This environment of dialogue likely influenced the co-learning that was reported.

V.3 Process, Development, and Overcoming Challenges

Most of the excerpts describe the challenges and resistances faced by FTA and 3PM that were overcome during the training process carried out in PIBID Physics 2022. Regarding these advances in perceptions about teaching, school, and students, provided by the project and FTA, there are excerpts in which the PIBID participants state:

[...] it enabled a more cohesive world between the student's reality and the knowledge of physics, which is how physics is approached. I came from another totally traditional world, [...] and I understood that the thematic approach manages to connect many more things that students see in their reality. (TES_U178_P17).

[...] I lost the single vision of that traditional classroom, which was what I faced throughout high school. And that was the foundation of what I knew about the classroom until then. So, coming into contact with the thematic approach and seeing the potential that a class can achieve [...] undoubtedly helped in my development. (TES_U165_P15).

Through the training process based on FTA, the PIBID participants took ownership of their future profession, so as not only to "teach" classes, but to create a curriculum based on the reality of their students. As the PIBID participants affirm, FTA, as a curricular perspective, makes it possible to reach students, making many connections with their reality and promoting more dynamism in the classroom. This development that the PIBID participants experienced is in line with what Freire states:

To have the critical awareness that one must be the owner of one's work and that "it constitutes a part of the human person" and that "the human person cannot be sold or sell itself" is to take a step beyond palliative and deceptive solutions. It is to engage in a true transformation of reality to humanize it and, in turn, humanize people (Freire, p.107, 1994).

Therefore, it is believed that the subjects narrowed the gap between who they are and what they do, bringing a more empathetic and critical view to their teaching practice. Furthermore, it is noticeable that many PIBID participants distanced themselves from transmissive physics teaching. Thus, overcoming such an intrinsic model was not a simple task and required a whole process of reconstructing what physics teaching should be, facing challenges and resistances, as reported in the following excerpts:

[...] such was my inexperience when I first took on this role, just as they did now, but given all the work done previously with the Reality Study and the training processes, it is practically a different reality. This is evidenced in the reports, where the notions of rethinking plans, reflecting on methodology, and listening to students are much more mature. (DI_U173).

I think that, from the perspective that we took up to Freire's Thematic Approach [...] conducting a dialogical, problematizing class is much more complicated than it seems, because, for me, it was not easy, it was not smooth [...] to discuss the problems, to bring up discussions involving the context, the issues, the themes we had, for me it was much more, it demanded much more of me [...]. (TES_U135_P13).

As can be seen in the units of meaning, the process of developing as a teacher in a dialogical and problematizing manner was not simple. Teaching work within the FTA curriculum perspective is more complex and demands more from the educator. This complexity can be understood in the explanation by Delizoicov, Angotti and Pernambuco's on the elements necessary to develop FTA:

A vision of the totality and comprehensiveness of reality; a rupture with common sense knowledge; adopting dialogue as its essence; requiring educators to adopt a critical stance, to constantly problematize, to distance themselves, to be in action, and to observe and criticize themselves in that action; pointing to participation, discussing collectively, and requiring the availability of educators (Delizoicov; Angotti; Pernambuco, 2011, p. 166).

These essential elements for addressing the reality of students in the classroom made the training process more arduous, which generated resistance among the subjects, as stated by the PIBID participant in the second excerpt above. However, it also made it more rewarding, as these PIBID students developed and grew in their teaching activities, overcoming obstacles and achieving an understanding of FTA and a dialogical and problematizing pedagogical praxis, changing their views on the work of educators and the reality of students.

Another interesting aspect is that the Research Group may have influenced, through example, the classroom practices of the PIBID participants to be more in line with this perspective. An indication that they observed the practices of the Research Group Participants in the training activities and considered this in their own practices can be found in the excerpts below:

While the “Gepecidianos” were guiding the discussions, I realized that the scene was not very different from a classroom, and even more similar to the way my core classes would be implemented (in pairs). (DI_U24).

[...] so when it came to planning, we had this experience with you, so it was more or less our guiding point, we didn't think, if we do it this way, it seems to be in line with what was worked on, with the ideas, with how that meeting was organized. (TES_U157_P14).

In this sense, according to Freire (1994) and Auler and Delizoicov (2015), the problems and dialogues provided to PIBID participants enabled practical examples so that they could overcome transmissive teaching. According to Pitano (2017, p.99), “More than

emancipating, through the overcoming and qualitative improvement of cognitive stages, Freire's dialogue is liberating, generating a revolutionary wisdom capable of founding a new subject". And this is only possible through a dialogical process, through a relationship of communication that was established within PIBID, as according to Paulo Freire:

In this sense, education and communication have a profound dialogical relationship: education is communication, it is dialogue, insofar as it is not a transfer of knowledge, but an encounter between interlocutors who seek the meaning of meanings (Freire, 2005).

Thus, it can be affirmed that the project was successful in training future physics educators capable of questioning the reality of students and engaging in dialogue, which has the potential to involve these students in their own experiences, in the real world, bringing real purpose to the teaching of Physics, as can be seen in the excerpts:

[...] it takes a while to understand what a problematization really is, you know? But [...] if it were not for the problematizations, for the three pedagogical moments, I do not think the classes would have been so good [...]. (TES_U73_P7).

[...] we set out to explore the element of dialogue. It is something I found difficult, but I intend, whenever I can, to try to make students more active in the classroom through dialogue. (TES_U149_P14).

The above excerpts highlight the capacity of the training process to develop the Freire "being more" in individuals. This can be seen when the PIBID participants state that they aim to achieve greater potential in their classes by seeking to make students more critical and connected to their reality through dialogue and problematization. Regarding this "being more", Delizoicov, Angotti and Pernambuco state that Paulo Freire

[...] has one of its ontological premises that the human being is incomplete and that the process of humanization makes them a being more. Hence, a need to consider the historicity of the constitution of human beings. It is therefore dedicated to analyzing educational processes in the sense of being more, which occur, as it argues, based on historical solutions to problems arising from the relationships of human beings with each other and with the natural and transformed world that surrounds them. (Delizoicov; Angotti; Pernambuco, 2011, p. 170).

Thus, Freire's "being more" goes beyond teaching, moving towards humanization, overcoming problems in the relationships of the world that surround them. Therefore, it is believed that PIBID Physics provided some progress in the "being more" of future teachers, in the sense that it promoted greater criticality about the purposes of teaching and a more sensitive view of realities.

The meeting of all subjects involved in the project and the presence of dialogue/communication throughout all moments and spaces of this PIBID seem to have enabled PIBID participants to learn about the TA perspective and teaching work. Thus, the excerpts from this category show that PIBID participants found in problematization and dialogue a way to bring their students closer to the classes. This, combined with a GT, can make these students more critical and participatory in their own realities.

V.4 Teaching Transformation and a New Educational Purpose

In this category, the units reveal that by learning about the reality of the communities in which the schools are located, the PIBID participants transformed themselves as educators, changing their ideas about what education should be like and how they view their students. The training process was able to generate transformation in future educators, as can be seen in the excerpts:

[...] that's what changed me the most about participating in PIBID, you know? And even more so when we work through the Generating Theme, when we get involved, we experience that reality more deeply, you know? We get to talk to people. So, this work humanizes us, I think it really helps us to be, in addition to teachers, more willing to seek transformation, you know? (TES_U36_P4).

[...] I understood that, like, first I have to understand my students, so that later they can understand what I want them to understand; it's very important. And I didn't have that vision before. I thought, like, wow, you have to give them content. (TES_U123_P12).

It is clear that in this process, by understanding the reality of the students and identifying the need for change, the PIBID student transformed himself/herself, coming to consider "knowing" who his/her students are as an essential part of reaching them in the classroom. Regarding this rupture with Banking Education that the training process influenced, Freire (2005, p.86) explains:

The fact is that if men are beings in search of something and if their ontological vocation is to become human, sooner or later, they may realize the contradiction in which "banking education" seeks to keep them and engage in the struggle for their liberation. [...] To maintain the contradiction, the "banking" concept denies dialogicity as the essence of education and becomes anti-dialogic; to overcome this, problematizing education – a gnosiological situation – affirms dialogicity and becomes dialogical.

Therefore, by becoming dialogical and requiring this attitude from its participants, the process led them to adopt a more humanistic view of teaching. Furthermore, the curricular restructuring in this initial training process brought a new meaning to education for the

participants of PIBID Physics, leading to a distancing from Banking Education, reinforced by the following points:

So, I think it gave me a new scope of what education is. [...] I think the thematic approach selected topics that are relevant in society, we can work not only with a new scope, but also with a more critical, reflective teaching, and that the student is a participant in that society, that he understands what that community is, the mistakes, the problems of that community, and how we can work on that in the classroom. (TES_U179_P17,).

To work on this generating theme, we need to deconstruct the image of the teacher as the holder of all knowledge, in contrast to the student. We can thus be close to the students, always making it clear that they are being evaluated and held accountable, but this does not have to make them feel diminished, and there are ways to do this. (DEF_U66).

The PIBID participants expanded their understanding of the role education should play in shaping citizens. Aiming to promote critical thinking (Auler; Delizoicov, 2015; Freire, 1994) and social participation (Rosa, 2019; Klein, 2021), to train students to critically view their own reality and transform it through active participation in solving the problems encountered therein.

Toti (2011) argues that citizenship education - understood by PIBID participants through practices, readings, and discussions involving FTA - occurs through dialogue in the classroom (Freire, 1994) and a focus on the importance of decision-making processes (Auler, 2011; Strieder, 2012), developing “responsible social action” - or social participation.

Thus, involvement with the reality of the community surrounding the school brings meaning to the educator's work. Going beyond the simple transmission of concepts. It can bring new meaning to students in the classroom, who will build knowledge and values that have the potential to mobilize them in their community and society.

Throughout the training process that took place at PIBID Physics, the PIBID participants consolidated new views on the teaching of Physics that is expected and the type of individual that is desired to be trained. There was also a transformation in the educational purpose of these future educators. This change can be seen in the following units:

In my view, our main objective is to assist in the human development of the individual. [...] It is important to do this, and it directly implies certain things in Physics. [...] It implies the way the city government is managed, for example. So, why isn't it interesting for the city government [...] to bring more bike lanes or other things? Oh, and what does that imply in physics? Well, in physics, you have displacement, you have time, you want to reduce these things, you generate less stress, it has to do with health. So there's physics, there's biology, I think it's all kind of interconnected. So yes, it is very important for human development as well, not just as a student. As a citizen. (TES_U154_P15).

There were also students who talked about their dreams, and that was good to see, some dream of a promising future, traveling, taking care of their families, and that is very heartwarming to read. [...] students, who seek respect, dignity, and equality, who hope for a future without fighting and less violence in which to live. (DI_U51).

The excerpts clearly explain the more human purpose that PIBID participants found for teaching Physics and for education as a whole. What was once perceived with a "gray heart" is now felt with a "red heart" (Dagnino; Silva; Padovani, 2011)¹¹, which seeks teaching for the exercise of citizenship, teaching for the development of critical thinking and social participation. In addition, future educators demonstrated that they were fulfilled with their professional choice, very closely linked to the new purpose they found through the training process, as perceived in the excerpts:

I can't deny it was exhausting. [...] but it's a very rewarding process. So, being able to finish this project, I feel very satisfied. Because we look back at how we started and all that material that was built, you know, and that will remain for the school. [...] So, I think it's a very good feeling, you know? We feel that we have left a legacy for the school, left a legacy for the students, anyway. (TES_U44_P5).

Another thing is that I was able to get very close to the students, so much so that, like, I don't think it is a coincidence that a girl told me she only came on Friday nights because of Physics, you know? I think the thematic approach, all the work of this PIBID, helped a lot with that, [...] So, for me, it was really cool to hear that. (TES_U74_P7).

It is essential that the training process enables educators, through dialogical praxis and FTA, to advance in "being more" and that this makes the educational purpose more possible. Corroborating this, in a dialogue by Ira Shor in the book *Fear and Daring*, we have:

Thus, all in all, perhaps you realized that teachers were a window and a path for students to see their own conditions and glimpse a different destiny. The teacher's face and speech can confirm domination or reflect possibilities for fulfillment. If students see and hear the teacher's contempt, boredom, and impatience, they learn, once again, that they are people who inspire disgust and annoyance. If they perceive the teacher's enthusiasm when dealing with their own moments in life, they may discover a subjective interest in critical learning (Freire; Shor, 1986, p. 22).

Therefore, educators' fulfillment with their work and their lives becomes fundamental for them to be a beacon of hope and change for their students. Based on the units, it can be concluded that the PIBID participants wanted to play the role of educators, without becoming unattainable figures for their students.

¹¹ "... especially those who work in the CTS field, and even more so those who are dedicated to ECTS, have a "red heart" (CV). They strive for social inclusion and a more just, equitable, and environmentally sustainable society." (Dagnino; Silva; Padovani, 2011, p. 104).

The FTA perspective itself distances individuals from transmissive teaching and provides this freedom in terms of strategies, surpassing KA. As argued by Muenchen (2010, p.49), in dialogue with Delizoicov, Angotti and Pernambuco:

The transposition of Freire's perspective proposes a new relationship between curriculum and the school community. [...] According to Delizoicov, Angotti and Pernambuco (2002), the most significant aspect of the proposal to transpose Freire's perspective to school education is the school curriculum. The structuring of educational activities, including the selection of content, breaks with the traditional curriculum paradigm, based on a conceptual approach.

Some excerpts explicitly mentioned Liberating Education, showing that some PIBID participants closely aligned themselves with the FTA perspective. They desire an education capable of enabling individuals to free themselves from their oppressive realities (Freire, 1994). This can be seen in the following excerpt:

[...] it is important to have the humility to recognize the role of the educator in understanding why students need Physics. Banking education and Liberating Education are in line with the answers provided in the presentations, in the sense of how education is and how we want it to be, where we want to go as Pibid. (DEF_U48).

Humility in teaching practice is a central to Freirean practice, because without it there can be no dialogue. Santos and Freire (2018, p.8) recognize the challenge that studying can be for students and state that Banking Education “fundamentally seeks to kill student's curiosity, investigative spirit, and creativity. Its “discipline” is discipline for naivety in the face of the text, not for indispensable critical thinking.”. In contrast to Banking Education, Brighente (2016, p. 165) highlights:

And it is precisely in their liberating pedagogical practice that educators can fight against the fatalism that capitalist society brings us, whether against unemployment, poverty, or high illiteracy rates. Education cannot be one that deposits, that encourages rote memorization, that trains (banking concept), but one that helps men and women, subjects of their history, to think critically, challenging them, giving them space to show their curiosity and their questions. Unlike banking education, which does not seek to raise the awareness of its students, it actually wants students to be unconscious and subject to its rules, thus perpetuating its vertical relationship.

It is argued that by giving education a social purpose and seeking to establish a dialogic/communicative environment in the classroom, Liberating Education can cause qualities and abilities to “flourish” in individuals that would otherwise be “pruned” by KA and Banking Education.

VI. Some Considerations

This research was developed based on the scarcity of projects such as PIBID/Physics 2022, as presented in the introduction by the literature review, as well as the scarcity of studies on PIBID projects guided by TA in the area of Physics Teaching and focused on teacher training, seeking to understand the potential that TA has, in its Freirean aspects, articulated with the initial training of Physics undergraduates. We return to the research problem: *"How does the process of curricular reorientation from the perspective of the Thematic Approach influence the initial training of PIBID participants in the Physics course at UFSM?"* As such, we sought to achieve the objective: *To investigate how the experience of a process of curricular reorientation from the perspective of TA influences the initial training of PIBID students in the physics course at UFSM.*

The data from the instruments used in the research showed that PIBID/Physics 2022, based on TA and organized by 3PM, enabled an initial training capable of preparing future educators to perform a problematizing and dialogical praxis in the classroom, build curricula centered on GT in an interdisciplinary and meaningful way for students¹², work collectively - in a way that allows for co-learning through dialogue, and, through a rigorous and empathic process, rebuild themselves as educators and human beings, seeking to "be more" and conceiving new purposes for their own teaching practice.

As already explained in the theoretical framework, TA is a perspective in which scientific concepts are subordinate to the theme, that is, the theme plays a central role in the curriculum. Thus, this research found that PIBID/Physics 2022 treated the theme as the most important link in the Teaching-Learning projects that were developed. This was possible through the 3PM as curriculum structures. Thus, it is understood that the main strand of TA in the project was FTA, with very significant approaches to the STS perspective, that is, approaching a Freire-STs TA. In fact, TA was confirmed in the results as an alternative to overcome the culture of transmissive, propaedeutic, fragmented, and mostly conceptual teaching, even when used by undergraduates in training environments, as it allows subjects to graduate with a new vision of teaching.

Furthermore, it was found that initial training that focuses on TA as the center of the practices experienced by undergraduates has the potential to enable teachers to develop curricula that are relevant to the reality of their students. In this regard, it is understood that PIBID is an ideal program for developing initial training in this sense, as it can offer an environment of dialogue and collective work that is essential for the development of TA practices that are more meaningful for teachers in training, enabling learning through praxis, involving undergraduates, teachers, schools, communities, and universities. This article argues for the maintenance and expansion of PIBID and for it to become an inherent part of teacher training.

¹² The Teaching-Learning projects, designed for the set of classes, can be accessed via the link: <https://sites.google.com/view/gepecid/pibid/projetos-de-ensino-aprendizagem>.

In general, the results presented clarified that despite complications in understanding and practices involving dialogue, problematization, and work with GT, the challenges were overcome and the true potential of dialogical and problematizing praxis in the context of FTA was developed. It is noteworthy that through a rigorous, empathetic, and collective process, the PIBID participants grew as educators. This involved the development and improvement of skills such as the elaboration of problematizations capable of provoking students on the topic, the generation and maintenance of a dialogical environment in the classroom, the use of the 3PM both as curriculum structurers and as didactic-pedagogical dynamics, and even the self-discovery of their own educational purposes, with a more human and transformative bias.

It is important to clarify that initial teacher training should be understood as part of a broader process of continuing education, since, as Freire (1996) points out, the act of teaching requires constant openness to human imperfection and the process of continuous learning. In this sense, teacher training does not end with graduation but extends into pedagogical practice and critical reflection on it, in a process of praxis. Authors who dialogue with Freire, such as Costa (2022) and Paniz (2007), reinforce this concept by emphasizing that initial training should promote reflexivity and problematization, preparing educators for a formative journey that is built throughout their lives, in dialogue with the school and social reality. Therefore, in the broad scope of teacher training, the initial moment that was researched, in the case of PIBID, is contemplated in what is understood as ongoing training by Freire's references.

Furthermore, the project analyzed is considered an effective example of how TA can be successful in the initial and ongoing training of teachers. It is hoped that the project and this discussion of its analysis may inspire new projects along the same lines, serving as an invitation to reinvent this practice, as well as contributing to research in TA, teacher training, and the articulation between initial training and, therefore, continuing training in programs such as PIBID. Nevertheless, this article contributes by presenting and problematizing possible paths, linked to investigations of reality, that are different from propaedeutic and transmissive Physics teaching.

In this sense, we advocate for the consolidation of PIBID as an intrinsic part of undergraduate courses and as a state policy, aiming at its stability and improvement in the quality of teacher training and, consequently, in the quality of Brazilian education. Finally, some questions arise that may contribute to future research: "How has TA, in the area of Science Education, been related to public policy contexts?" and "How could the PLACTS perspective¹³ be inserted and relate to the training process presented?"

¹³ Latin American Thought in Science-Technology-Society.

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