EDUCAR EM REVISTA
Universidade Federal do Paraná | Setor de Educação
ISSN 1984-0411

https://doi.org/10.1590/1984-0411.97094-T

DOSSIER

Teaching practices of undergraduate teacher trainers

Practitioner research in internship and the practice of teacher educators

O estágio com pesquisa e a prática de formadores de professores

Leandro de Oliveira Rabelo[a]
rabelo@utfpr.edu.br

Maria Lucia Vital dos Santos Abib[b]
mlabib@usp.br

Cristiano Rodrigues de Mattos[c]
crmattos@usp.br

ABSTRACT

This paper presents a proposal for organizing practitioner research during teaching internship, developed within two courses in a Physics teacher education program. To better understand this proposal, we analyzed the practices of the teacher educators in conducting these courses. Our analysis draws on Cultural-Historical Activity Theory to characterize the formative actions within the context of these courses. The research data derive from a doctoral study that investigated the implementation of one edition of the courses. Specifically, we analyzed data from classroom recordings and field journal notes. The results indicate that the activities required active participation from the pre-service teachers through collective work, problematization of issues related to education, Physics teaching, the teaching profession, collective evaluations, and shared decision-making processes regarding rules, topics, and actions within the courses and internships. Based on these actions, we characterized the formative activity developed in the courses, whose intended outcome was to foster initial teacher education from a critical-reflective perspective. We highlight that the educators' practices sought to address the diversity of teaching-related challenges by interweaving thematic and methodological dimensions, aiming to incorporate the experiences and knowledge of the pre-service teachers and promote the study of topics aligned with their formative needs, as identified through classroom discussions and practicum experiences.

Keywords: Teacher Training. Internship. Practitioner Inquiry. Physics Teaching. Activity Theory.

RESUMO

Neste trabalho, apresentamos uma proposta de organização do estágio com pesquisa, desenvolvida no âmbito de duas disciplinas de um curso de formação inicial de professores de Física. Buscando compreender

[a] PhD in Education, Universidade de São Paulo (USP); Professor, Universidade Tecnológica Federal do Paraná (UTFPR), Curitiba, Paraná, Brazil.

[b] PhD in Education, Universidade de São Paulo (USP); Professora, Universidade de São Paulo (USP), São Paulo, São Paulo, Brazil.

[c] PhD of Physics, Universidade de São Paulo (USP); Professora, Universidade de São Paulo (USP), São Paulo, São Paulo, Brazil.

melhor essa proposta, analisamos a prática de formação docente desenvolvida nas aulas dessas disciplinas. Tomamos como base a Teoria da Atividade Sócio-Histórico-Cultural para caracterizar as ações da atividade de formação no contexto dessas disciplinas. Os dados da pesquisa derivam de uma investigação de doutorado que examinou o desenvolvimento de uma edição dessas disciplinas. Em particular, foram analisados dados provenientes das gravações das aulas e dos registros em caderno de campo. Como resultado, identificamos que as ações exigiram a participação ativa dos licenciandos por meio do trabalho coletivo; da problematização de questões relacionadas à educação, ao ensino de Física e ao trabalho docente; das avaliações coletivas; e do compartilhamento de decisões sobre regras, temas e ações das disciplinas e dos estágios. A partir dessas ações, caracterizamos a atividade de formação docente no contexto das disciplinas analisadas, cujo resultado almejado foi promover a formação inicial docente em uma perspectiva reflexivo-crítica. Destaca-se que formação docente analisada busca abordar a diversidade dos problemas de ensino, entrelaçando dimensões temáticas e metodológicas, com o objetivo de incorporar as vivências e os saberes dos licenciandos e promover o estudo de temas alinhados às suas necessidades formativas, resultantes das discussões em aula e das experiências nos estágios.

Palavras-chave: Formação de Professores. Estágio. Pesquisa sobre a Prática. Ensino de Física. Teoria da Atividade.

Introduction

Research on one's own practice is viewed by many authors as fundamental for improving teacher training (André, 2001; Diniz-Pereira, 2011; Cochran-Smith *et al.,* 2009; Dana; Yendol-Hoppey, 2009). In initial training, research on one's own practice assumes distinct characteristics, as undergraduates typically conduct their investigations in single, short-term projects (Rutten, 2021). Even with this limitation, there is evidence that research on one's own practice can contribute to the training of future teachers (Mule, 2006; Hagevik; Aydeniz; Rowell, 2012; Clarke; Fornillier, 2012).

In the context of initial teacher training in Brazil, research on one's own practice assumes special importance during internships (Pimenta; Lima, 2017), whose proposals are characterized by what is known as an internship with research (Ghedin; Oliveira; Almeida, 2015). This internship perspective

> involves study, analysis, problematization, reflection and the proposition of solutions to teaching and learning situations; experience situations of teaching, learning to elaborate, execute and evaluate teaching projects; knowledge, the use of techniques, methods and strategies to teach in different situations; the ability to read and recognize the theories present in the pedagogical practices of school institutions (Pimenta; Lima, 2017, p. 240-241).

Despite the importance of research internships for the initial training of teachers, there are still few articles published in national journals that address this theme in the area of Science Teaching (Rabelo; Abib; Higa, 2024). Even among studies that address this theme, there is a lack of explanation regarding how educators' teaching practices are characterized. This makes it difficult to propose the internship with research by other educators, as several doubts arise about how to materialize this practice in initial teacher training.

Considering the gap in research and the importance of studying the teaching practices of trainers who organize undergraduate internships, mediated by research on their own practices, we present this work, which aims to analyze a proposal for an internship with research, called Teaching Research Projects (TRP). This proposal was developed within a research group and has as its main context of application the disciplines of Physics Teaching Methodology I and II (MEF I and II) of a Physics Teaching Degree course at a public university in the state of São Paulo.

Based on previous research (Rabelo; Abib, 2018; Rabelo; Azevedo; Abib, 2020; Rabelo; Abib; Azevedo, 2021; Rabelo, 2022; Rabelo; Abib; Azevedo, 2023; Rabelo; Abib; Higa, 2024), we conclude that research on one's own practice is not capable of generating teacher training processes from a critical-reflective perspective. Other actions are needed to support the foundation of the research carried out by undergraduates, fostering critical reflection, autonomy, and creativity. In this sense, we formulate the following question: how is the teaching practice of teacher training characterized in the context of the MEF I and II disciplines for the development of internships with research?

To answer this question, based on the Cultural Historical Activity Theory (Leontiev, 2021; Engeström, 2001), we analyzed the teacher training activity developed in this context, which assumes an internship with research as a structuring axis, seeking to characterize the mediating elements and the actions that constitute it.

Internship with research in the training of Science teachers

In the first decades of teaching degree courses in Brazil, internships were centered on observing and imitating the practices of experienced professors, who were seen as models to be followed. This method presupposed that teaching and learning consisted of the application of practices pre-established by specialists, relegating future teachers to the role of imitating such models. Over time, changes in educational contexts and teaching theories gradually altered the stages. From the 1970s onwards, influenced by behaviorism, internships began to emphasize the observation of desirable behaviors and skills, aiming to train future teachers. This transition incorporated diversified practices and attempts to apply innovative proposals in the training of interns, marking the beginning of studies on teacher training and internships in science education. However, this traditional approach reinforced the dichotomy between theory and practice, subordinating the teacher's role to the technical application of established theories, reflecting the prevailing model of technical rationality.

From the questions that arose in subsequent decades about the ineffectiveness of the traditional model of teacher training in promoting effective science teaching for students, an in-depth debate on teacher training began. Abib (1997) summarizes that this training frequently resulted in teachers who replicated the disjointed practices and predominant values of their own training trajectory. These professionals presented classroom practices centered on the passive transmission of supposedly neutral, truthful content that was disconnected from the needs of developing critical and participatory citizens (Abib, 1997).

In the face of the crisis perceived in both educational and formative processes, new approaches to internships have emerged, seeking to modify traditional practices in teacher training and science education. In this sense, Demo (1992) proposed new conceptions of the teacher's role, aiming to produce knowledge that would go beyond reproductive and transitory didactics. In this same context, the works of Donald Schön (1992) emphasize the importance of reflection and formative processes that enable teachers to develop knowledge based on their practices. This ideology inaugurated the practical-reflective model, which Stenhouse (1991, p. 194) observed is grounded in"(...) the idea is that of an educational science in which each class is a laboratory and each teacher is a member of the scientific community". This new formative paradigm integrates previous ideas of action research in teacher education (Carr; Kemmis, 1986), inaugurating the embryonic proposal of internships with research. This approach was later developed with several theoretical-methodological perspectives, including research on classroom practices, development projects, and various educational themes related to Science.

With the deepening of research on teacher training, studies revealed the limitations of the practical-reflective model. This model, which is predominantly focused on procedural and practical reflections in the classroom, often neglects the essential integration between teachers' personal knowledge and academic knowledge. This gap prevented the explicit incorporation of reflections on broader social issues, which are essential for training critical, autonomous teachers engaged in transformation processes (André, 2001; Contreras, 2002; Zeichner, 2008), a characteristic of the critical-reflective model. Subsequently, as the understanding of the limitations of the practical-reflective model broadened and the critical-reflective model in teacher training was configured, new opportunities for research and internships with an investigative focus were developed and explored (Diniz-Pereira, 2011; Ghedin; Oliveira; Almeida, 2015; Pepper; Lima, 2017; Azevedo; Abib; Testoni, 2018). This movement of transformations in science education, teacher training, and practicum models is summarized in Table 1.

Table 1: Models of science education, teacher training, and internships

Period	Science Education	Teacher Training	Internship
The 60s	Traditional	Imitation and improvisation	Observation Imitation
The 70s	Traditional Didactic Laboratory (Behaviorism)	Technical Model Training	Observation Application
The 80s	Activities with different theoretical tendencies (behaviorism, constructivism, etc.)	Technical Model	Observation Application
The 90s	Activities with different theoretical tendencies (behaviorism, constructivism, etc.)	Technical Model Practical-reflective model	Observation Application Reflections on practice
2000s and beyond	Activities with different theoretical tendencies (behaviorism, constructivism, teaching by inquiry, etc.)	Technical Model Practical-reflective model Critical reflective model	Observation Application Practical reflections Critical Reflections Projects Investigative authorial practices

Source: Rabelo, Abib e Higa (2024).

From Table 1, we observe that, over the last few years, there has been an evolution in the formative practices of the internships, influenced by changes in educational proposals in Science and by the growing interest in studies on teacher training. These transformations have expanded both training practices in internships and research in this area, emphasizing the need to develop new approaches, especially those focused on research. It is in this context that the proposal of the TRP emerged as a way of organizing the internship with research in the initial training of teachers.

Origin and development of the Teaching Research Project (TRP)

The proposal for the development of the TRP is the result of successive analyses of training practices conducted by the teacher trainer and subsequent investigations with collaborators from the research group Laboratory of Research and Teaching of Physics – Development of Education in Science and Mathematics (LAPEF – DECIM). Initially presented in the professor's doctoral thesis (Abib, 1997), the central ideas of the proposal were developed based on Piagetian principles, with a primary focus on the challenges faced by future teachers regarding the processes of teaching and learning as a structuring axis of actions during supervised internships. This initial study demonstrated the gradual transformation of the participants' teaching-learning conceptions, generally moving from a vision centered on the transmission of knowledge to a problematizing approach to teaching Physics.

Subsequently, other theses and dissertations defended by members of the research group contributed to the evolution of the internship with research proposal, culminating in the current configuration characterized by the TRP (Jordão, 2005; Azevedo, 2018; Galindo, 2012; Cunha, 2013; Testoni, 2013; Castro, 2015; Rabelo, 2022). In addition to these graduate research efforts, within the scope of the group, a postdoctoral investigation was also conducted focusing on the process of constructing the problem-question of the TRP by undergraduate Physics students (Higa, 2017).

Through these investigations and the learning accumulated throughout its development, the TRP proposal has evolved with diverse theoretical and methodological foundations, stemming from Educational Psychology, Science Teaching, and Teacher Training. More recently, it has been enriched by the principles of the Cultural-Historical Activity Theory (Vygotsky, 2001; Leontiev, 2004; Engeström, 2001), contributing to the improvement of training practices and a better understanding of the development processes of future teachers (Azevedo; Abib; Testoni; 2018; Rabelo; Abib; Azevedo, 2021; Rabelo; Azevedo; Abib, 2020).

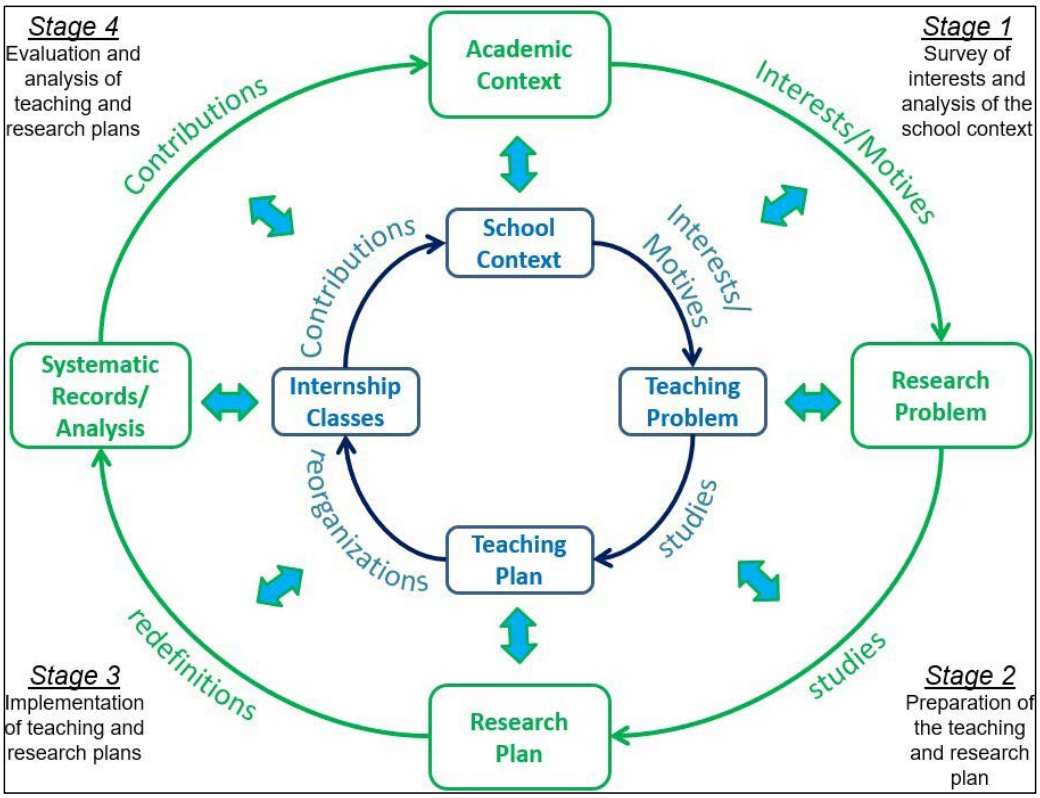
Accordingly, although the TRP continues to be a research-based practicum model under constant reflection and transformation, we consider that the outcomes of these studies have consolidated a structure of formative actions that currently define its implementation stage. Below, we present this structure of TRP actions.

Structure of actions of the Teaching Research Project

In the TRP proposal, the licentiate students carry out integrated activities in two main dimensions during the internship: the teaching dimension, which addresses strategies to teach specific content in specific contexts and with clear objectives; and the investigative dimension, which involves theoretical and methodological choices to investigate the effectiveness of these strategies in the students' learning process while conducting activities at school.

The four stages of TRP development are represented in Figure 1.

Figure 1: Stages of performing the TRP



Source: adapted from Rabelo and Abib (2018, p. 4).

In Figure 1, the actions of the teaching and research dimensions of the TRP are illustrated in internal and external circles. Although they are represented separately to facilitate the visualization of the actions carried out at school and university, it is essential to understand that these dimensions are interconnected and interdependent in the development of TRP In addition, the phases of the TRP should not be interpreted as sequential and linear, as it is common to find elements of previous phases as the process progresses.

At each stage of the TRP, there is a specific objective that distinguishes it from the others, as described in Table 2 below.

Table 2: Stages and actions of the TRP

Stage	Share	Description
1	Survey of interests and analysis of the school context	In the initial stages of the disciplines with an internship workload, licentiate students have several training needs that become apparent throughout the process. In the first stage of the TRP, a systematic survey of these needs is carried out through questionnaires, exploring themes such as the importance of Science Teaching and the concepts of teaching and learning. These answers are analyzed by both the licentiate students and the teacher, promoting the sharing of interests and meanings. In addition, the interns investigate school contexts and the teaching of Physics through research with high school graduates, aiming to understand their experiences and perceptions. These strategies aim to sensitize licentiate students to problem situations often found in schools, encouraging them to seek more dynamic and effective teaching approaches.
2	Preparation of the teaching and research plan	After raising their initial interests and analyzing the school context, the interns are guided to reflect on issues they wish to explore during the course and internship. Initially broad, these questions can address challenges such as motivating students, dealing with discipline issues, and finding more effective teaching methods. With the mediation of the teacher and through collective discussions in the classroom, licentiate students should be able to refine their questions to focus on concrete problems related to the school reality of the internship, as well as the contents and methodologies of the TRP. This process culminates in the formulation of a teaching-research problem that integrates the dimensions of teaching and research. Interns are then guided to develop a teaching plan that is articulated with a research plan, involving the study of academic research relevant to the identified problems and the proposed methodologies. The plans are presented and discussed collectively in the following classes to incorporate suggestions and ensure consistency between the project's objectives and its execution strategies.
3	Implementation of teaching and research plans	The interns conduct the activities as planned in the teaching plan, under the supervision of the teacher responsible for the internship at the school. At the same time, they document the conduct through audio and video recordings, as well as field notes, to collect information that supports the analyses provided in the established research plan. During this process, it is essential to note that the teaching and research plans are flexible, enabling continuous adjustments to internship activities. The undergraduates share their work in the classroom, promoting discussions and suggestions among colleagues.
4	Evaluation and analysis of teaching and research plans	The interns conduct a comprehensive analysis of the developed process, reflecting on the teaching and research problems formulated, as well as on the experiences they have had in the school. To promote a deeper and more systematic reflection, they present their analyses in a poster session held during the last class of the TRP, with the support of colleagues and the teacher, to broaden and deepen the discussions.

Source: Authors.

It is essential to highlight that the four stages of the TRP offer an understanding of the internship proposal with research, but do not follow a linear and uniform sequence. In addition, these stages do not end by returning to the starting point, as illustrated in Figure 1, but develop in an expansive movement, in which the accumulated experiences generate new perspectives, needs, and motivations, influencing the future development of research activities in teaching.

In the situations addressed, the stages of the TRP present particular characteristics, considering the interests of the licentiate students and the reflections promoted through interactions among the various participants in the internship, including university professors, monitors, school employees, classmates, and basic education students. These interactions enrich discussions and actions with a range of theoretical and practical elements. The dynamics of the educational process also contribute to this diversity, as each class and each internship subject are unique, even when following an initial plan. This process is flexible and continually refined through the individual reflection of the teacher in charge and dialogue with the undergraduates, who actively participate in defining the themes and actions of the classes.

To broaden and deepen the reflection on the implications of the internship with research, carried out through the TRP, for the initial training of teachers, we resorted to the Theory of Activity. Thus, before presenting these reflections, we expose some of the assumptions of this theory that guided us throughout this work.

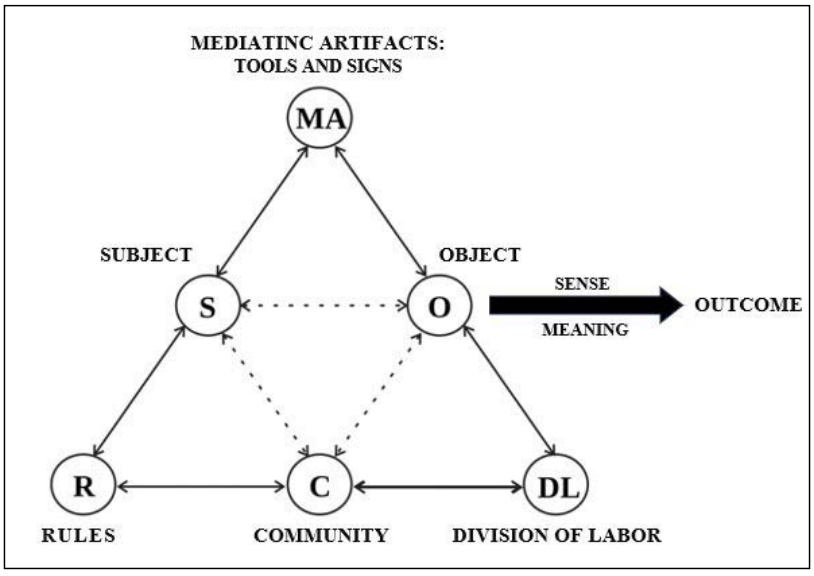
Socio-Cultural-Historical Activity Theory

The Cultural-Historical Activity Theory, grounded in historical-dialectical materialism, centers on the dialectical relationship between human activity and consciousness. In this theory, development is conceived as a historical-cultural process in which human beings, by transforming nature, simultaneously transform themselves, in a human-mundane dialectical process.

For Leontiev (2010, p. 68), activity can be characterized as "the processes psychologically characterized by what the process, as a whole, is directed to (its object), always coinciding with the objective that stimulates the subject to perform this activity, that is, the motive". Additionally, the activity is composed of a set of coordinated actions, whose specific purposes are related to the objective of the activity (Leontiev, 2021). Actions, in turn, depend on objective conditions, which are referred to as operations.

Engeström (2001) developed a model that allows for the analysis of the process of development and transformation of human activity, considering the mediations between the subject, community, and object (Figure 2).

Figure 2: Model of the structure of human activity



Source: adapted from Engeström (2001, p. 135).

The model presented in Figure 2 is an expansion of Vygotsky's mediation model, as it includes, in addition to the cultural instruments (CI), which express the mediations between subject

and object (S-O), Engeström explicitly includes the community (C) as a mediating element in this relationship. Thus, the elements represented in the central triangle of Figure 2 constitute a dialectical unity, expressed by the trinomial Subject-Community-Object (S-C-O). This trinomial requires other mediations between each pair that compose it. Thus, in addition to the cultural instruments (CI), the rules (R) represent the mediations between subject and community, expressing the norms that regulate the relationship between the subject(s) of the activity and the community; the division of labor (DT) expresses the mediations between the community and the object of the activity, delimiting the specific attributions of the subjects in the collective work of producing the object of the activity.

By introducing this triangular model, Engeström (2001) refers to a "system of activity" to express the structural complexity of the coordination of actions and activities developed in human life. In this way, concrete daily life can be understood as composed of several systems of activities that interact at different hierarchical levels, mutually influencing one another and forming a complex network of mediated interactions that develops over time.

Research Procedures and Context

In this work, we assume historical-dialectical materialism as the philosophical basis, which enables us to understand the object as a totality of totalities, identifying the units of analysis that comprise the totality of the system to which they belong (Vygotsky, 2001).

The data from this study were derived from a doctoral research project on internship, with research conducted through the TRP (Rabelo, 2022). In this investigation, two disciplines were followed – MEF I and MEF II – taught in a Physics Degree course at a public university in the state of São Paulo.

In the year we conducted the data collection, MEF I and MEF II had, respectively, 24 and 20 undergraduates, and were taught in 15 and 16 classes. In these mandatory subjects, licentiate students must complete 90 hours of internship in basic education schools, preferably in public schools. In addition, internship orientation meetings were held at different times from the classes, conducted by a monitor (a doctoral student).

Because of this context, the process of data construction was developed throughout the disciplines, through the registration of information from different sources: survey of written documents – internship reports with research; questionnaires to characterize the profile of the undergraduates, including the meanings attributed to teaching and teaching Physics; video recordings of the MEF I and II disciplines; semi-structured interviews with the undergraduates at the beginning of MEF I and the end of MEF II; and audio recordings of the internship orientation meetings held with the undergraduates.

For this work, which aims to characterize the teaching practices of teacher training carried out in the MEF I and II disciplines, we focused, more specifically, on the recordings of classes and the field notebook records. The recordings were watched in full and manually minutiaed in the field

notebook. The minutes consisted of writing the events of the classes, recording the time at which they occurred, a brief description of the event, and the subjects' statements. After this procedure, a summary of each class was prepared on a worksheet, including a description of the episodes that comprised each meeting (Rabelo, 2022).

From these data, we analyzed the practice of teacher training in the development of classes in the disciplines. Drawing on Cultural-Historical Activity Theory (Leontiev, 2021; Engeström, 2001), we adopted the activity system of the courses as the unit of analysis to characterize the actions that comprised the teacher education activity within this instructional context.

Findings

By analyzing the recordings of classes for MEF I and II disciplines, as well as the field notebook records, it was possible to identify different phases that characterized the training practice developed (Rabelo, 2022). Below, we present a synthesis of the three phases identified in MEF I and the two phases identified in MEF II.

Phases and actions of the Physics Teaching Methodology I

In Table 3, we present a summary of the phases of MEF I, as well as the actions carried out at each moment of the course.

Table 3: Summary of the actions carried out in MEF I

Phases MEF I	Actions/Objectives
I	a) Presentation of the course proposal and the supervised internship with research b) Application of a questionnaire to get to know the undergraduates c) Research and reflection on the Teaching of Physics carried out in basic education schools d) Studies and discussions on evaluation, teaching-learning, and teaching work
II	a) Studies and discussions on learning theories (Ausubel, Piaget, and Vygotsky) b) Analysis of discursive interactions in a Physics class c) Studies and discussions on the role of the teacher, teaching knowledge, teacher training, and teacher-researcher of one's own practice d) Evaluations of the course program and reflections on the theoretical studies carried out e) Presentation of the TRP proposal to the undergraduates
III	a) Presentation and discussion of the TRPs of the undergraduates b) Studies and collective discussions on experimentation, History and Philosophy of Science in the Teaching of Physics, and the relationship between Mathematics and Physics c) Analysis and reflection on MEF I, the internship, and the proposal of the TRP

Source: Authors.

The actions of the first phase of the MEF I discipline aimed to understand the interests and perspectives of the undergraduates. This was achieved through initial and characterization questionnaires completed by the undergraduates, whose answers were collectively analyzed in the classroom. This analysis revealed that the licentiate students had different experiences and views on

the teaching of Physics, influenced by their varied educational trajectories. During these discussions, it was identified that many licentiate students held teaching-learning conceptions based on traditional models of knowledge transmission, which motivated debates about the need to transform these views through theoretical readings and discussions in the classes.

In addition, investigations were conducted to understand how former high school students perceive the importance of teaching Physics in their lives, highlighting challenges such as the difficulty in relating Physics to everyday life and the perception that the discipline is viewed more as something instrumental than essential. These reflections also led to debates about the difficulties in modifying established educational practices, considering the working conditions of teachers, as well as institutional and social resistance.

In the second phase of MEF I, undergraduates studied theories of learning, including those of Ausubel, Piaget, and Vygotsky. They organized themselves into groups to discuss book chapters and complementary texts, producing collective syntheses about each theory. In the following classes, they related these theories to the teaching practices observed during the internship in schools. In addition, they analyzed discursive interactions in Physics classes, using different types of argumentation. At the end of the phase, they reflected on the theoretical progress of the discipline and discussed topics such as the role of the teacher, teaching knowledge, and didactic intervention projects – although some undergraduates faced delays in the internship schedule.

In the third phase of the MEF I course, undergraduates conducted studies on experimentation in Physics teaching, exploring six texts that offered different perspectives on the subject. In groups, they discussed the role and importance of experimentation, as well as the various methods for conducting it in Physics classes. From the discussions, they elaborated a list of fundamental aspects, which was later collectively refined in the next class. At the same time, two TRPs were presented, highlighting the practical application of experimentation as a teaching strategy.

Next, the undergraduates studied the History of Science in the context of Physics teaching, with discussions on the use of this approach and an analysis of how it is treated in textbooks. Again, TRPs were presented, highlighting both the challenges and possibilities of integrating the History of Science into teaching practices. Discussions were also held on the relationship between Mathematics and Physics, exploring how mathematical reasoning structures students' physical thinking. This generated reflections on the importance of articulating these two disciplines in the curriculum and teaching methodologies.

At the end of this phase, the classes were dedicated to the final presentations of the TRPs, in which the undergraduates shared their research and experiences. In addition, there was a collective reflection on the learning throughout the course, highlighting the integration between theory and practice, the importance of research on pedagogical practices, and the challenge of addressing teaching and research problems in a more focused and applicable manner to the internship context.

Phases and actions of the Physics Teaching Methodology II

In Table 4, we present a synthesis of the phases of MEF II, as well as the actions carried out at each moment of the course.

Table 4: Summary of the actions carried out in MEF II

Phases MEF II	Actions/Objectives
I	a) Presentation of the assumptions and proposal of the TRP b) Studies and collective discussions on: crisis of Science Teaching, scientific literacy, curriculum of Physics Teaching; Science, Technology, Society and Environment/Socio-Scientific Issues in the Teaching of Physics; and teaching and school work c) Research on the Teaching of Physics carried out in the internship schools through interviews with collaborating teachers d) Reflections and evaluations on the process of carrying out MEF II
II	a) Presentation and discussion on TRPs b) Conducting experiments by investigation, as well as collective discussion about this teaching methodology c) Studies and collective discussions on: teaching work, scientific knowledge, entrance exams, and curriculum; Science, Technology, Society and Environment/Socio-Scientific Issues; textbook; and the relationship between Physics and Mathematics

Source: Authors.

In the first phase of the MEF II course, the teacher began by recalling fundamental topics previously discussed in MEF I, including learning theories, the interrelationship between Mathematics and Physics, experimentation in science teaching, and the use of History and Philosophy of Science (HPS). Additionally, students completed detailed questionnaires aimed at mapping their expectations and interests. Then, the classes focused on debates and critical analyses of science teaching, addressing crucial issues such as scientific literacy, different conceptions of curriculum, STS/SSI approach (Science, Technology and Society / Socio-scientific Issues) in Physics Teaching, and the teaching work and school context.

Practical investigations were also conducted in the internship schools, including the formulation of questions for interviews with collaborating teachers, to understand how these teachers plan and execute their classes, thereby connecting the theories discussed in the classroom with the teaching practices developed in the schools. Additionally, there were TRP planning actions (developed in groups of two to three undergraduates) and collaborative discussions on the topics to be prioritized in subsequent classes, as well as on the organization of TRP presentations.

In the second phase of the MEF II course, the undergraduates focused on the TRPs. They began with the presentation of the proposal and examples of previous TRPs, emphasizing the importance of critical reflection and research in teaching practice. The undergraduates also presented their own TRPs, organized by similar themes, to facilitate in-depth discussions. At the same time, they studied experimentation by investigation, carrying out experiments on the buoyancy of bodies.

In addition, undergraduates participated in studies and discussions on the relationship between teaching work, scientific knowledge, entrance exams, and curriculum, as well as on

STS/SSI, textbooks, and the articulation between Physics and Mathematics. They also conducted a self-assessment of the discipline through individual questionnaires and a collective evaluation.

It is worth mentioning that many of these studies and discussions were introduced in the classes through suggestions from the licentiate students themselves and demands brought from the internship schools. The actions “application of a questionnaire to get to know the undergraduates”, “investigation and reflection on the teaching of Physics carried out in basic education schools”, and “interviews with collaborating teachers on the teaching of Physics in internship schools” aimed to identify the interests and training demands of the undergraduates as well as issues related to the context of the schools in order to find relevant topics to be dealt with in the classes of these disciplines. Thus, there were three main sources of themes for study and discussion in the classroom: (i) the internship schools (experiences of the licentiate students and investigations with the collaborating professors); (ii) the interests and training demands of the undergraduates themselves; and (iii) the studies in the area of Science Teaching that the teacher in charge considered important for teacher training.

In addition to these actions, internship orientation meetings were held at various times, separate from the regular classes of the disciplines, to support undergraduates. These meetings, conducted by the monitor under the guidance of the professor responsible for MEF I and II, addressed general aspects of the disciplines (theoretical texts and questions about the preparation of the works) and the internship, aiming to assist the licentiate students in the preparation, execution, and evaluation of the TRPs. In addition to serving as a space for discussion on the particular cases of TRPs, these meetings raised issues and themes that were addressed in MEF I and II classes. This occurred through weekly planning meetings between the teacher and the monitor/researcher, during which the classes for the disciplines were organized. The monitor/researcher’s reports on the orientation meetings brought relevant elements to be considered in reformulating the class planning.

For the evaluation in each discipline, undergraduates prepared an individual internship portfolio throughout the semester, following the professor’s guidelines. The portfolios brought together all the individual and collective works developed throughout the course and the supervised internship. In general, they contained: (i) critical summaries of the theoretical texts studied; (ii) internship report containing the title of the TRP, characterization of the school context, justification of the project, description of the development (objectives, investigative focuses/questions, teaching/class plans of the main activities developed, description of the activities, among others), analysis of the realization process, conclusions, bibliography and annexes; (iii) personal analysis of the internship and discipline; and (iv) internship forms signed by the school’s collaborating teacher, the discipline teacher and the school management. These reports were evaluated based on previously explained criteria and discussed with the undergraduates.

Activity System of MEF I and II

The activities of the MEF I and II disciplines in 2019 focused on the teacher trainer, a monitor-researcher, and undergraduates, with the teaching-learning process as the object of study. The desired result was to promote initial teacher training from a reflective-critical perspective, through the articulation between theory and practice, and internship with research, along the lines of TRP, with an emphasis on the development of praxis.

To achieve this objective, the teacher employed several cultural instruments, establishing mediations between the subjects and the object. Among these instruments, the following stand out: questionnaires to characterize the licentiate students and the teaching carried out in schools; texts on various topics related to teaching and the teaching of Physics; investigations on the teaching of Physics in schools; discussions and collective work; orientation meetings; and presentations of the proposals and results of the TRPs.

Concerning the rules present in the activity system, some mediated the relationship between the subjects (teacher, licentiate students, and monitor/researcher) and the community, regulating the mandatory supervised internship in the Physics Teaching Degree course – such as, for example, the requirement of 180 total hours of internship in the MEF I and II disciplines, others guided the interactions between the subjects of the activity, such as the elaboration of syntheses of the theoretical texts before classes and the delivery of individual portfolios for evaluation.

Based on the relationships between subjects, community, and object, the division of labor was established: the teacher was responsible for planning and mediating the teaching-learning actions in the classes; the monitor/researcher assisted the teacher and conducted the internship orientation meetings with the undergraduates; and the undergraduates performed the tasks proposed in the classes and internships, in addition to participating in orientation meetings with the monitor/researcher.

In the activity system, other members of the university community (professors, undergraduates from other classes, and employees) also played a relevant role, providing subsidies for the elaboration of the TRPs. In many cases, the knowledge and experiences acquired in other disciplines, as well as interactions with colleagues at the university, were mobilized by undergraduates during internships in the MEF I and II disciplines.

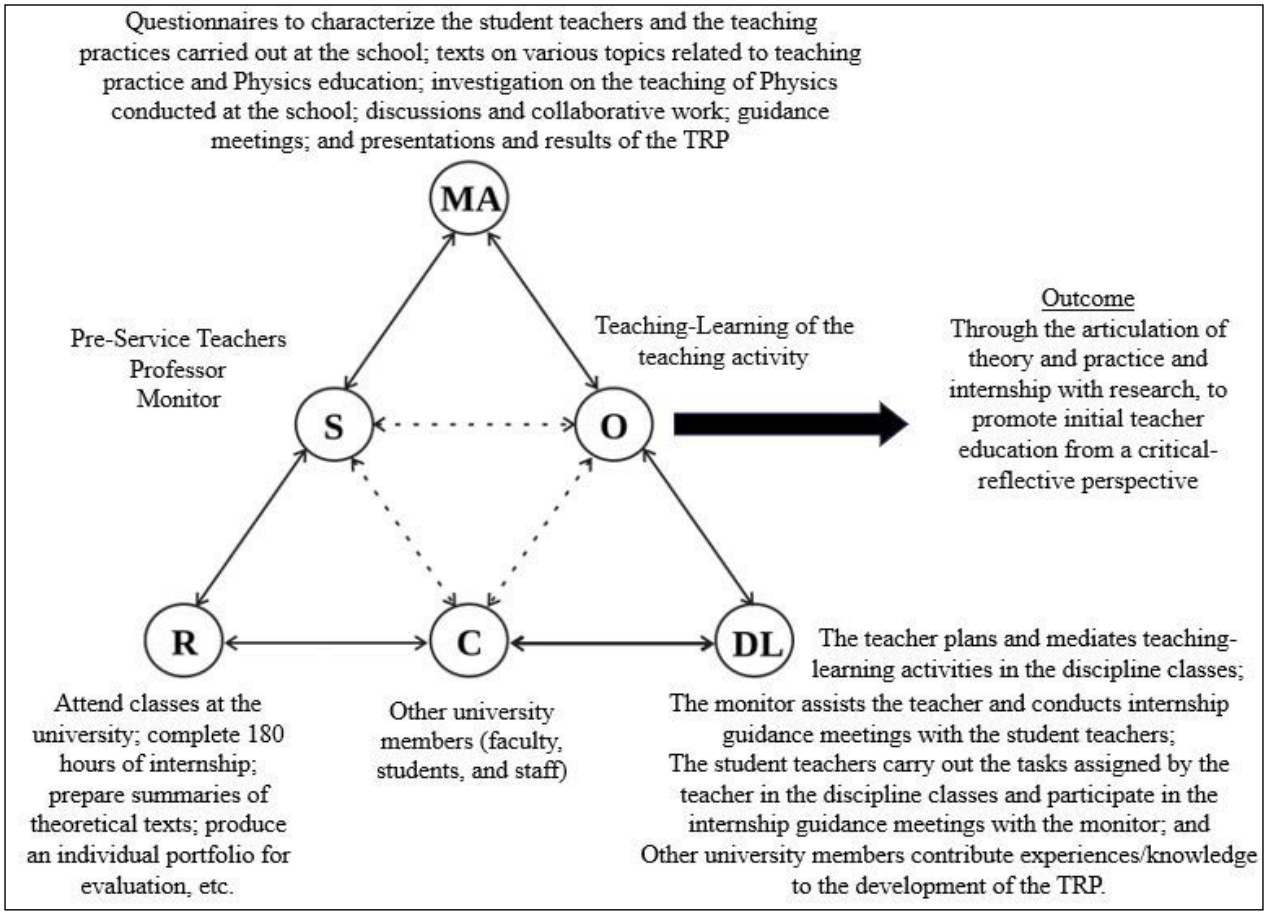
Thus, based on this information, we can characterize the activity system of the MEF I and II disciplines as represented in Figure 3. Although the MEF I and II disciplines are distinct activities, we chose to present them in the same figure because we consider that, when analyzed in general, they share the same mediating elements, differing only in the ways these activities are performed through their actions carried out.

The system of activities for the MEF I and II disciplines demonstrates the complexity of undergraduate training in this context. The evolution of pedagogical actions reflects this multiplicity, demonstrating the incorporation of diverse resources, such as discussion of theoretical

texts, evaluations, collective decisions, and records of experiences, that enrich the training of undergraduates. This transformation is driven by the teacher's practice, characterized by an open and semi-structured process that adapts to the formative demands and contradictions emerging during the internship with research. Such dynamics enable the increase of cultural instruments and signs in the system of activity of the disciplines.

The different ways of carrying out activities in MEF I and II are observed in Tables 3 and 4, which summarize the main actions carried out in each discipline. The syntheses of the actions developed in the different phases of the activities allow us to visualize more clearly the similarities and differences between the two disciplines. In both, the beginning was centered on the critical questioning of the teaching of Physics practiced in schools. Among the actions carried out, the investigations with high school graduates at MEF I and with collaborating teachers of internship at MEF II stood out.

Figure 3: MEF I and II activity system



Source: Authors.

In addition, the readings and theoretical discussions in the two disciplines advanced from more general themes of the teaching activity and the teaching of Science to more specific themes of the methodologies of Physics teaching. For example, in MEF I, the themes of teaching-learning,

evaluation, and teaching work were initially addressed. Then, more specific issues were explored, such as experimentation and History and Philosophy of Science. Similarly, in MEF II, the initial themes included crisis in science education, scientific literacy, and curriculum. Only from the fifth class, especially in the second phase of the course, more specific themes in Physics teaching began to be discussed, such as STS/SSI, experimentation through investigation, and the relationship between Physics and Mathematics.

Another common characteristic of the MEF I and II disciplines is the appreciation of collaborative work and the exchange of experiences among the participants. In other words, the actions carried out were not only focused on the teacher and the monitor, but also required the active participation of the licentiate students in the classes. This characteristic is evidenced by actions that privileged: the division of tasks that required the collective work of the undergraduates; the joint problematization of issues related to education, the teaching of Physics, and the teaching work; collective evaluations; and the sharing of decisions on rules, themes and actions of the disciplines and internships.

Such characteristics are fundamental for teacher training, as the exchange of experiences and knowledge among undergraduates enriches the elements for creation and imitation during the supervised internship, to develop a creative praxis (Vázquez, 2003).

Among the differences between MEF I and II, it is noteworthy that, although the internship with research was proposed from the beginning of MEF I, it was only from the tenth class onwards that this proposal was made explicit to the undergraduates. In MEF II, from the beginning, this proposal was presented by the professor through presentations on the TRP, as well as examples of internship projects with research developed by graduates in previous years. This indicates that MEF I was configured as a moment of preparation and approximation with the proposal of an internship with research, made possible by the TRP. Thus, after the experience lived in MEF I, the undergraduates were able to have greater clarity about the development of TRPs in MEF II.

Final considerations

In this work, we focus on the formative practice of teacher educators in the development of the discipline of Physics Teaching Methodology, which assumes as a fundamental and structuring characteristic the realization of internships with research in the form of Research Projects in Teaching. Given the innovative character of this form of internship – as the Teaching Research Projects, when developed through research on teaching, attribute to the formative practice of trainers a permanent challenge of overcoming the approaches traditionally used in the development of curricular internships in undergraduate courses – it becomes necessary to understand its specificities and formative implications.

From this perspective, the central issue is to promote praxis through research projects in teaching that, given their investigative character, highlight both the teaching-learning actions of

future teachers and the theories that underlie them as they are confronted with concrete classroom situations and brought into discussions in the relevant disciplines. As a result, the practice of trainers is shaped by a dynamic that seeks to address the diversity of problems arising from teaching situations, fostering an intertwining between the thematic and methodological dimensions. This dynamic has the following essential parameters: (1) To incorporate the diversity of experiences, knowledge and values of the undergraduates, as well as the motives that mobilize them in the learning of teaching; (2) To promote the study of themes that seek to converge with the training needs of future teachers, outlined, on the one hand, by the combination of elements from the discussions promoted in the classes of the disciplines and from the experiences in the internships; and, on the other hand, by the contributions of trainers in the area of Physics Teaching and research on teacher training.

With this direction, the complexity of the teacher training activity that we aim to highlight in this work is represented in the training activity system, which underscores the close relationships that intertwine teaching and research during the internship. The mediations established between the elements of the activity system show a formative practice sustained by different instruments and signs, which both delimit and drive the actions of the subjects involved in the internship. It is also noteworthy that the practice of the teacher responsible for the course was characterized by an open and semi-structured process, built to different degrees by the participants of the course – the teacher, the monitor-researcher, the future teachers, the collaborating teachers and other actors – who contribute with their possibilities and experiences at each moment of a process guided by the search for praxis, both the undergraduates and the trainers involved.

Despite these results, it is essential to emphasize the need for further research that expands our understanding of the internship's impact on initial training, as well as on the dynamics of transformation and the interrelations between the various systems of activity involved in this process.

References

ABIB, Maria Lucia Vital dos Santos. *A construção de conhecimentos sobre ensino na formação inicial do professor de física:* "agora, nós já temos as perguntas...". Tese (Doutorado em Educação) – Universidade de São Paulo, São Paulo, 1997.

ANDRÉ, Marli (org.). *O papel da pesquisa na formação e na prática dos professores*. Campinas: Papirus, 2001.

AZEVEDO, Maria Nizete de; ABIB, Maria Lucia Vital dos Santos; TESTONI, Leonardo André. Atividades investigativas de ensino: mediação entre ensino, aprendizagem e formação docente em Ciências. *Ciência e Educação*, v. 24, n. 2, p. 319-335, 2018. https://doi.org/10.1590/1516-731320180020005

CARR, Wilfred; KEMMIS, Stephen. *Becoming critical:* education knowledge and action research. Londres: Falmer Press, 1986.

CASTRO, Beatriz Aparecida Caprioglio de. *O professor de física em formação:* seus motivos, ações e sentidos. Tese (Doutorado em Educação) – Universidade de São Paulo, São Paulo, 2015.

CLARKE, Pier Junor; FOURNILLIER, Janice. Action research, pedagogy, and activity theory: Tools facilitating two instructors' interpretations of the professional development of four preservice teachers. *Teaching and Teacher Education*, v. 28, n. 5, p. 649-660, 2012. https://doi.org/10.1016/j.tate.2012.01.013

COCHRAN-SMITH, Marilyn; BARNATT, Joan; FRIEDMAN, Audrey; PINE, Gerald. Inquiry on inquiry: Practitioner research and student learning. *Action in Teacher Education*, v. 31, n. 2, p. 17-32, 2009. https://doi.org/10.1080/01626620.2009.10463515

CONTRERAS, José. *Autonomia de professores*. São Paulo: Cortez, 2002.

CUNHA, Alexander Montero da. *Saberes experienciais e estágio investigativo na formação de professores de física*. Tese (Doutorado em Educação) – Universidade de São Paulo, São Paulo, 2013.

DANA, Nancy Fichtman; YENDOL-HOPPEY, Diane. *The reflective educator's guide to classroom research:* learning to teach and teaching to learn through practitioner inquiry. Thousand Oaks: Corwin Press, *2009.*

DEMO, Pedro. Formação de formadores básicos. *Em Aberto*, v. 12, n. 54, p. 23-42, 1992.

DINIZ-PEREIRA, Júlio Emílio. A pesquisa dos educadores como estratégia para construção de modelos críticos de formação docente. *In:* DINIZ-PEREIRA, Júlio Emílio; ZEICHNER, Kenneth. *A pesquisa na formação e no trabalho docente*. 2. ed. Belo Horizonte: Autêntica, 2011. p. 2-20.

ENGESTRÖM, Yrjö. Expansive learning at work: Toward an activity theoretical reconceptualization. *Journal of Education and Work*, v. 14, n. 1, p. 133-156, 2001.

GALINDO, Mônica Arantes. *O professor da escola básica e o estágio supervisionado:* sentidos atribuídos e a formação inicial docente. Tese (Doutorado em Educação) – Universidade de São Paulo, São Paulo, 2012.

GHEDIN, Evandro; OLIVEIRA, Elisangela Silva; ALMEIDA, Whasgthon Aguiar de. *Estágio com pesquisa*. São Paulo: Cortez, 2015.

HAGEVIK, Rita; AYDENIZ, Mehmet; ROWELL, Glennon. Using action research in middle level teacher education to evaluate and deepen reflective practice. *Teaching and Teacher Education*, v. 28, n. 5, p. 675-684, 2012. https://doi.org/10.1016/j.tate.2012.02.006

HIGA, Ivanilda. *Estágio investigativo:* a construção de uma questão-problema e mudanças de perspectivas de futuros professores de física sobre o ensino. Relatório de pós-doutorado – Universidade de São Paulo, São Paulo, 2017.

JORDÃO, Rosana dos Santos. *Tutoria e pesquisa-ação no estágio supervisionado:* contribuições para a formação de professores de biologia. Tese (Doutorado em Educação) – Universidade de São Paulo, São Paulo, 2005.

LEONTIEV, Alexei Nikolaevich. *O desenvolvimento do psiquismo.* 2. ed. São Paulo: Centauro, 2004.

LEONTIEV, Alexei Nikolaevich. Uma contribuição à teoria do desenvolvimento da psique infantil. *In:* VIGOTSKI, Lev Semionovitch; LURIA, Alexander Romanovich; LEONTIEV, Alexei Nikolaevich. *Linguagem, desenvolvimento e aprendizagem*. 11. ed. São Paulo: Ícone, 2010. p. 59-83.

LEONTIEV, Alexei Nikolaevich. *Atividade, consciência e personalidade*. Bauru: Mireveja, 2021.

MULE, Lucy. Preservice teachers' inquiry in a professional development school context: implications for the practicum. *Teaching and Teacher Education*, v. 22, n. 2, p. 205-218, 2006. https://doi.org/10.1016/j.tate.2005.09.011

PIMENTA, Selma Garrido; LIMA, Maria Socorro Lucena. *Estágio e docência*. São Paulo: Cortez, 2017.

RABELO, Leandro de Oliveira; AZEVEDO, Maria Nizete de; ABIB, Maria Lucia Vital dos Santos. Professora experiente em atividade investigativa sobre a docência no estágio da licenciatura em Física. *Revista de Ensino de Ciências e Matemática*, v. 11, n. 5, p. 243-260, 2020.

RABELO, Leandro de Oliveira; ABIB, Maria Lucia Vital dos Santos; AZEVEDO, Maria Nizete de. Estágio com pesquisa na formação inicial de professores: transformação dos sentidos sobre a atividade docente. *Ciência & Educação*, Bauru, v. 27, 2021. https://doi.org/10.1590/1516-731320210001

RABELO, Leandro de Oliveira. *Estágio com pesquisa e aprendizagem expansiva:* reflexão crítica, autonomia e criatividade para o desenvolvimento da práxis docente. Tese (Doutorado em Educação) – Universidade de São Paulo, São Paulo, 2022.

RABELO, Leandro de Oliveira; ABIB, Maria Lucia Vital dos Santos; AZEVEDO, Maria Nizete de. Estágio com pesquisa: formação crítico-reflexiva de futuros professores de Física. *In:* SIMPÓSIO NACIONAL DE ENSINO DE FÍSICA, 25., 2023, Curitiba. *Anais [...]*. Curitiba: SBF, 2023.

RABELO, Leandro de Oliveira; ABIB, Maria Lucia Vital dos Santos; HIGA, Ivanilda. Estágio com pesquisa na formação de professores: tendências em artigos na área de ensino de ciências. *Desafios – Revista Interdisciplinar da Universidade Federal do Tocantins*, Palmas, v. 11, n. 4, 2024. http://dx.doi.org/10.20873/Dossie_Est_Superv__2024_2

RABELO, Leandro de Oliveira; ABIB, Maria Lucia Vital dos Santos. Projeto de investigação à docência no estágio supervisionado da licenciatura em Física. *In:* ENCONTRO DE PESQUISA EM ENSINO DE FÍSICA, 17., 2018, Águas de Lindóia. *Anais [...]*. Águas de Lindóia: SBF, 2018.

RUTTEN, Logan. Toward a theory of action for practitioner inquiry as professional development in preservice teacher education. *Teaching and Teacher Education,* v. 97, p. 103194, 2021. https://doi.org/10.1016/j.tate.2020.103194

SCHÖN, Donald. Formar professores como profissionais reflexivos. *In:* NÓVOA, Antonio (coord.). *Os professores e sua formação*. Lisboa: Dom Quixote, v. 2, 1992. p. 77-91.

STENHOUSE, Lawrence. *Investigación y desarrollo del curriculum*. Madri: Morata, 1991.

TESTONI, Leonardo André. *Caminhos criativos e elaboração de conhecimentos pedagógicos de conteúdo na formação inicial do professor de física*. Tese (Doutorado em Educação) –Universidade de São Paulo, São Paulo, 2013.

VYGOTSKY, Lev Semionovitch. *Construção do pensamento e da linguagem*. São Paulo: Martins Fontes, 2001.

ZEICHNER, Kenneth. Uma análise crítica sobre a "reflexão" como conceito estruturante na formação docente. *Educação & Sociedade*, v. 29, p. 535-554, 2008. https://doi.org/10.1590/S0101-73302008000200012

_____

Contribution: Author 1 – conception and design of the research; construction and processing of data; analysis and interpretation of data; preparation of the final text; Author 2 – conception and design of the research; construction and processing of data; analysis and interpretation of data; preparation of the final text; Author 3 – analysis and interpretation of data; preparation of the final text.
Support or funding: This work was carried out with the support of the Coordination for the Improvement of Higher Education Personnel - Brazil (CAPES) - Financing Code 001 and the São Paulo Research Foundation (FAPESP) - Financing Code 2022/08293-6.
Availability of research data: The entire dataset supporting the results of this study is available upon request to the author Leandro de Oliveira Rabelo.
Responsible editors – Associate Editors: Márcia de Souza Hobold and Isabel Maria Sabino de Farias; Editor-in-Chief: Angela Scalabrin Coutinho.
Translator: Sofia Bocca.

How to cite this article:
RABELO, Leandro de Oliveira; ABIB, Maria Lucia Vital dos Santos; MATTOS, Cristiano. Internship with research and the practice of teacher trainers. Practitioner research in internship and the practice of teacher educators. *Educar em Revista,* Curitiba, v. 41, e97094, 2025. https://doi.org./10.1590/1984-0411.97094

Received: 09/30/2024
Approved: 06/15/2025