University Teaching: Teacher Training in the Area of Computer Science

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Revista Internacional de Educação Superior
International Journal of Higher Education

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Submmited: 27 June. 2021
Accepted: 24 Aug. 2022
Published: 28 Sept. 2022

doi 10.20396/riesup.v9i00.8666190
e-location: e023043
ISSN 2446-9424

ABSTRACT

The university teacher education is a historical challenge constituted since the origin of the university itself because its primary nature is related to research. Computer Science training for Higher Education, in particular, represents a challenging theme in university reality and academic-scientific studies. In this sense, we present, in this article, a study carried out in the Department of Computer Science at the Federal University of Bahia in Salvador- Brazil. As a methodology, we used qualitative research and action-research, through literature review, classroom observation, and training of the professors of the referred department. In this study, we seeks to contribute to the discussion about university teacher education in Computer Science, to understand the needs of the area and the systemic relationship that should contribute to Computer Education and the dissemination of computational thinking. As a result, we observed that the training offered at the Post-Graduation level to university professors could be instituted in an interdisciplinary way, with didactic-pedagogical and specific directions, emphasizing the constitution of knowledge necessary for the exercise of teaching in Higher Education. There is still an emphasis on research to the detriment of the formation of university professors at the Master's and Doctoral levels, with the absence of systemic action among the various teaching modalities as well as reflections on teaching practice in Higher Education.

KEYWORDS

Higher education teacher training. Higher education. Computer science education.

Docência Universitária: Formação Docente da Área de Ciência da Computação

RESUMO

A formação docente universitária configura-se como um desafio histórico constituído desde a origem da própria universidade devido a sua natureza principal ser relacionada à pesquisa. A formação em Ciência da Computação para o Ensino Superior, em específico, representa-se com uma temática desafiadora na realidade universitária e em estudos acadêmico-científicos. Nesse sentido, este artigo apresenta um estudo realizado no Departamento de Ciência da Computação na Universidade Federal da Bahia (UFBA), em Salvador- Brasil. Como metodologia, utilizou-se a pesquisa qualitativa e pesquisa-ação com procedimentos direcionados à revisão de literatura, observação em sala de aula e formação dos docentes do departamento referido. Este estudo busca contribuir para a discussão sobre a formação docente universitária na Ciência da Computação, de modo a compreender as necessidades da área e a relação sistêmica que deveria contribuir para o Ensino da Computação e a disseminação do pensamento computacional. Como resultado, observa-se que as formações oferecidas na Pós-Graduação aos professores universitários poderiam ser instituídas de maneira interdisciplinar com encaminhamentos didático-pedagógicos e específicos, enfatizando a constituição dos saberes necessários ao exercício da docência no Ensino Superior. Ainda nota-se a ênfase dada à pesquisa em detrimento à formação do docente universitário em nível de Mestrado e Doutorado, com ausência de uma atuação sistêmica entre as várias modalidades de ensino, bem como reflexões sobre a prática docente no Ensino Superior.

PALAVRAS-CHAVE

Formação docente universitária. Ensino superior. Ensino de computação.

Docencia Universitaria: Formación de Professores em el Área de Ciencia de la Computación

RESUMEN

La formación docente universitaria se configura como un desafío histórico constituido desde el origen de la propia universidad debido a que su naturaleza principal está relacionada con la investigación. La formación en Informática para la Enseñanza Superior, en concreto, representa un tema desafiante en la realidad universitaria y en los estudios académico-científicos. En este sentido, este artículo presenta un estudio realizado en el Departamento de de Ciencias de la Computación de la Universidad Federal de Bahía (UFBA), en Salvador - Brasil. Como metodología, se utilizó la investigación cualitativa y la investigación-acción con procedimientos dirigidos a la revisión de la literatura, la observación del aula y la formación de los profesores del referido departamento. Este estudio busca contribuir a la discusión sobre la formación de profesores universitarios en Ciencias de la Computación, para entender las necesidades del área y la relación sistémica que debe contribuir a la Enseñanza de la Ciencias de la Computación y a la difusión del pensamiento computacional. Como resultado, se observó que la formación ofrecida en la Postgraduación a los profesores universitarios podría instituirse de forma interdisciplinaria con orientaciones didáctico-pedagógicas y específicas, enfatizando la constitución de los conocimientos necesarios para el ejercicio de la docencia en la Enseñanza Superior. Se sigue constatando el énfasis dado a la investigación en detrimento de la formación del profesorado universitario a nivel de Máster y Doctorado, con la ausencia de una acción sistémica entre las distintas modalidades de enseñanza, así como de reflexiones sobre la práctica docente en la Enseñanza Superior.

PALABRAS CLAVE

Formación docente universitaria. Enseñanza superior. Enseñanza de computación.

1 Introduction

The challenges of teacher training have instigated numerous academic studies, particularly with regard to the role of the bachelor university teacher in Higher Education. In general, universities have a significant responsibility in preparing the professionals who will act in society, beyond the construction of specialized technical-scientific knowledge, being concerned with ethical values and social commitment.

> [...] train competent professionals in tune with the demands of today's world, who have a sense of social justice and a deep identity with democratic citizenship, is a task that requires much more from these teachers than to pass on the contents of their area of specialization stricto sensu (ALMEIDA; PIMENTA, 2011, p. 07).

In view of the dimension of the social role of the university, there is a need to reflect on the training of its teachers and the institutionalization of a University Pedagogy. It is worth pointing out that teaching should go beyond the vocational perspective, as well as the mere induction of the transposition of technical and scientific knowledge in a given classroom. The process of teaching in any modality demands much more complex actions than just mastering an area of knowledge. It shows the university's mission to keep teaching professionals intensely in tune with the social needs of the world of work in its broadest sense (theoretical and political).

University pedagogy has been historically constituted and widespread studies impose a need for deepening a praxis focused on teaching and its didactic specificities, as a vast literature urges, e.g., Cunha (2006); Pimenta; Anastasiou (2014); Almeida (2012), Soares; Cunha (2010); Almeida and Pimenta (2011); Imbernón (2009); Imbernón (2011); Pimenta (2012); Tardif (2012). In this context, the relevance of university teacher training is discussed, addressing the conception of these authors.

The productions of Massa (2013) and Massa; D'Àvilla (2013) deal with the didactic-pedagogical training of teachers in the area of Computing in Higher Education and report their limitations in the exercise of teaching. Specifically, in the area of Computer Science, Wing's (2006, 2009) productions appear in a pioneering way and are the basis for strategies to develop computational thinking, whose contributions have boosted the studies and the possibilities of mobilizing the teaching of Computing in different educational modalities.

The silences of absent pedagogical training have repercussions from the constitution of the university teacher identity to the experiences of systematization of knowledge in the Computation classroom, which could promote possible searches for the development of computational thinking. It can be observed that university teachers, in many cases, need initial and continued training to act in the reality of Higher Education.

This article is divided into five more sections, the next one dealing with the need for didactic and pedagogical training of university professors. Section 3 is aimed at discussing the specifics of university teaching in the area of Computer Science courses. Section 4 brings the

systematization of information related to the methodological approach used in the research. Finally, the results of the research are presented in Section 5 and the final considerations are indicated in Section 6.

2 The need for university teacher training

To understand the role of teaching, it is important to know its origin and meaning. According to Soares and Cunha (2010), the word teaching originates from the Latin "*docere*", translated as teaching, and its action also comes from Latin, with the term "*discere*" which stands for learning. Thus, teaching means a two-way link between teaching and learning. Teaching, as the exercise of teaching, involves all the aspects that permeate learning. In Higher Education, teaching has peculiar characteristics, whose main activities are centered on teaching and research activities (SOARES; CUNHA, 2010). In view of this, the university is a significant locus of formation both for its professionals and for society.

It is interesting to the study to understand how the knowledge about the exercise of teaching is constituted. Tardif (2012, p. 54) defines the meaning of teaching knowledge as "plural knowledge, formed by several knowledges coming from training institutions, professional training, curricula, and daily practice". In this sense, a qualified training in educational institutions that mobilizes knowledge related to the act of teaching and learning is essential in the construction of teachers' knowledge.

Thus, the author delineates a characterization based on the teachers themselves and on the knowledge, they use affectively in their practice, namely: knowledge of professional training directed to educational sciences (theories and methods); disciplinary knowledge (referring to knowledge in each area of knowledge); curricular knowledge (selected and categorized by school institutions); and experiential knowledge (essentially constituted on the basis of daily work). When it comes to teaching practice, a professional must be prepared considering its scientific, technical, technological, pedagogical, cultural, and human dimensions.

Teaching knowledge is established throughout teachers' theoretical and practical formative experiences, and, in the course of this period, it can be constituted into pedagogical knowledge. It is worth noting that pedagogical knowledge: "are those that come from teacher training and the exercise of teaching and concern the skills, knowledge, and attitudes mobilized as responses to everyday school situations" (D'ÁVILA, 2013, p. 25). Therefore, the constitution of university teaching knowledge should be a constant search of the university to promote the qualified training of professionals who circulate in society.

Regarding teacher education, Soares, and Cunha (2010, p. 25-26) reflect on the constitution of university teachers' knowledge, describing the various nuances of pedagogical practice in relation to the learning process of cognitive, affective-emotional, skills, and attitudes

development of students, among other possibilities of the university reality. Thus, the constitution of this knowledge should occur in graduate courses, as well as in the course of performance in the exercise of the profession.

Almeida (2012) explains that university teaching is characterized by three dimensions: professional, personal, and organizational. The first refers to the elements that define their training (initial and continuing) with the construction of their teaching identity. The second one points out the relations of involvement and commitment with teaching that helped the teacher to face the challenges throughout his career. Finally, the organizational dimension is directed to the conditions of organization, conduction, and remuneration of the work, as well as the level to be reached in performance. These dimensions characterize the configuration of "being a teacher" in Higher Education and can be articulated in several formative processes throughout the teacher's career for the constitution of their identity with mastery of theoretical and contextual elements of professional performance.

Moreover, the teaching action in Higher Education, especially in courses of predominance of the areas of excessive use of scientific rationality, has the perspective of transposing the actions of technical stance. In this case, little manages to use essential features of the teaching profession such as unpredictability, uniqueness, conflict, and instability (PIMENTA; ANASTASIOU, 2014). Consequently, the lack of initial and continuing teacher education in several areas compromises broader reflections on teaching throughout the professional's academic career.

Therefore, one can highlight the need for group reflective capacity for the development of teacher education. Thus, teacher training goes beyond technical performance, because it involves a collective process that can help define actions and decisions relevant to the educational act. The teaching action cannot be considered a mere scientific, pedagogical, and didactic updating. It must, previously, be a movement of building spaces for participation, reflection, and training so that people learn and adapt to be able to live with change and uncertainty. Emphasis must be placed on the learning process of people and the possibilities of making teaching a real and meaningful act (IMBERNÓN, 2011).

In university teaching, another limitation is experienced in teaching: the strict emphasis given to research. It seems that, in the university teaching career, the field of research is presented as structuring the profession in the process of knowledge construction. On the other hand, teaching is considered to have low academic and social prestige as an expression of socialization and dissemination of knowledge. This shows the need to advance in the perspective of understanding the dimensions of teacher performance and the constitution of their professional identity in Higher Education, not directed to evaluation systems that measure only the performance of the teacher as researcher and little investigate teaching in a broader way (CORRÊA et al., 2011).

The constitution of the teaching identity refers to much broader dimensions of the teaching work in which it is necessary to understand how they interact with others, with the

context, their life experiences and how they articulate with their professional activities. It means privileging a training based on reflexivity for teachers to analyze what they are or want to be and what they do and how they do it (IMBERNÓN, 2009, p. 75). A reflective teacher must have as the focus of analysis his or her experiences as a teacher, knowing how knowledge is constituted through action. It means introducing reflective mechanisms in which the teacher becomes a researcher of his own practice in action (PIMENTA, 2012).

Graduate Programs are a privileged locus of training for university teaching in which theoretical and instrumental knowledge for conducting research are systematized, and generally do not show training focused on teaching and learning processes. It is necessary, then, to overcome this superimposition of research in Higher Education and to value other dimensions of teaching. Higher Education still faces limitations in what concerns the characterization of the formation of university professors for a broader professional performance, considering the triad of teaching, research, and extension. In a broader sense, every educational process demands from the teacher the understanding of his role as a mediator in order to promote the internalization of certain knowledge by the student. This makes teachers offer their students educational conditions of qualified realization of the act of knowing (ALMEIDA; PIMENTA, 2011).

3 University Teaching in Computer Science

In the area of Computer Science, the university professor, due to initial training in bachelor's degree, has his academic path in teaching or research instituted by means of stricto sensu post-graduation courses. In view of this historically instituted education, it can be observed that the teachers have an intense grounding in scientific rationality, because they have chosen a course in Exact Sciences with these characteristics. Such training favors technical-scientific knowledge to the detriment of other areas of knowledge, particularly the Human Sciences as in the area of Education (MASSA; D'ÁVILA, 2013).

In an article published in the Workshop on Education in Computing (WEI), conducted by the Brazilian Computer Society (SBC), the studies of Massa (2015) demonstrate the possibilities and limitations of teacher training in Higher Education in Computing. Her studies were developed in the courses of Systems Analysis and Information Systems of Campus II of the State University of Bahia (UNEB), in the city of Alagoinhas, and found that teachers oscillate between the transmissive model and the reflective model, according to her reports.

The researcher also identified that Higher Education teachers, in the absence of adequate pedagogical training, use their empirical experience or performance references observed in their teachers throughout their trajectory as undergraduates - as also pointed out by the research of Anastasiou (2011), when analyzing teaching in Higher Education and its trajectory. Consequently, Massa (2015) concluded that the lack of initial and continuing education in the formation of the teaching professional in Higher Education culminates in the

overvaluation of their professional experience, as well as in the empiricism of the exercise of teaching itself.

It is noted that the National Post-Graduation Plan - PNG (2011-2020) structures the Postgraduation system in five discussion axes that should guide the actions of the Programs throughout the country, as follows below:

> 1 - the expansion of the National Postgraduation System (SNPG), the primacy of quality, breaking the endogeny and attention to reducing asymmetries; 2 - the creation of a new national research agenda and its association with the Postgraduation; 3 - the improvement of the evaluation and its expansion to other segments of the S,T&I system; 4 - the multi- and interdisciplinary among the main features of the Post-Graduation and important research topics; 5 - the support for basic education and other levels and modalities of education, especially high school (BRASIL, 2010, p. 15). 15).

It is observed in the delimitation of the axes presented in the document, the inexistence of an item that contemplates teacher training for Higher Education, with greater emphasis on the induction for research. In this case, studies point to the absence of Curricular Components in the Plans of the Courses of Graduate Programs in Computing related to didactic-pedagogical training that led the teaching actions in Higher Education (MORAIS, ROSA, MARINHO, MATOS, 2018; MORAIS, ROSA, MATOS, SOUZA, CARNEIRO, 2019).

Certainly, this absence of the discussion of teacher training aimed at Higher Education necessary for PPG generates grounds for possible scientific studies, as stated by Massa (2015). It is shown, then, an emphasis on the training of research development in the country. However, how to train good researchers without good teachers? This contradiction highlights the intense need for the university professor to become aware of the importance of didactic studies to improve his relationship with the knowledge that must be systematized, his relationship with the discipline, with the students and with his own teaching constituted throughout his history (IMBERNÓN, 2012).

CAPES (2013a), when disclosing the results of the Evaluation of programs, reveals that the Post-Graduation in Brazil had a 23% growth in the triennium presented in 2013. In this news released, the president of the mentioned Coordination, at the time Mr. Jorge Almeida Guimarães, highlighted a relevant item of the evaluation, namely: the social insertion of the course represented by the integration of the Post-Graduation program with basic education and the training of teachers for this level of education. There is also an indication that consolidated, and well evaluated courses help newer programs (CAPES, 2013a).

Another significant news released by CAPES (2016) refers to the need for articulation between Post-Graduation and basic education discussed at the opening of the third week of Triennial Evaluation in the year 2013. In a statement, the director of Basic Education Teacher Training of CAPES, Mrs. Carmem Moreira de Castro Neves, states that there is an urgent and fundamental need for articulation between graduate studies and basic education. The director

also evaluates that Postgraduation in Brazil cannot have considerable numbers if the quality of basic education is unsatisfactory (CAPES, 2016).

In the triennial evaluation document from CAPES (2013b) about the Graduate Programs in Computer Science released in 2013, it is shown in the evaluation items a concern with the interdisciplinary nature of the area and its possible contributions to the Elementary and Secondary Education. In this case, the Graduate Programs in Computer Science need to offer an interdisciplinary teaching education, as well as research and extension subsidies to other levels of education in order to reach the guidelines established in the official documents released by CAPES itself.

In Computer Science Teaching, the development of computational thinking[1] should guide teaching practices at all levels of education. Jeanette Wing (2006) pioneered the term computational thinking when referring to the various analytical probabilities in Computer Science. The concept advocated by the author is related to the potential of the area in the face of the need to develop computational thinking in which it is intended for problem solving, abstraction, decomposition, automation, simulation, modeling, recursive, sequential, and parallel thinking (WING, 2006).

According to the author (2006), computational thinking is configured as a possibility for subjects to solve problems and not to think like computers. It can be observed that the teaching of Computing over the years requires a teacher training that enables the best teaching strategies for the dissemination of computational thinking in order to conduct meaningful learning in the various levels and modalities of education. However, there is a lack of studies in the field of computational thinking development in higher education.

In this context, the demands placed on the career of the university teacher in Computing point only to initial technical and scientific training in bachelor's degree, transferring the responsibility of specific training for teaching to graduate courses (MASSA; D'ÁVILA, 2013). However, graduate courses in Computing are concerned with training researchers and do not provide adequate qualification for teaching more broadly.

The concern with university teaching, particularly in Computing, is restricted to the curricular component of Methodology of Higher Education (Didactics of Higher Education or equivalent discipline) in few graduate programs (MORAIS et al., 2018). Moraes et al., (2018, 2019), dealing with the documental analysis of the stricto sensu Post-Graduation courses in the area of Computer Science, identified, quantitatively, how the Post-Graduation Programs (PPG) have implemented disciplines and activities for the didactic-pedagogical training of the Higher Education teacher. This is because it can be considered one of the possibilities of offering Postgraduation students future teacher training, since the Exact Sciences areas, as is the case of

[1] In the area of Computer Science, there are theoretical disagreements about the use of the terms computational "thinking" and "reasoning". However, we chose to use the term "thinking" because we share the understanding presented by Ferreira et al. (2015, p. 257) that "computational reasoning is used more specifically, when thinking is related to analytical thinking and deductive reasoning - which involves logic and mathematics".

Computing, do not provide opportunities for experience in this field. In this case, the teacher in the area of Computing, generally, becomes a teacher based on the elementary empiricism of subjective experience and reproduces the management of the classes taught by their Undergraduate teachers, as Imbernón (2012) points out.

As D'Ávila (2013) states, teaching activity should be constituted of a broader social practice that combines knowledge, skills and attitudes, expectations and perceptions of the world related to diverse life histories of teachers. These indications demonstrate a significant aspect of reflection to think the teaching of Computing in Brazil, especially in Higher Education due to the intense demand for training professionals who will act in society.

4 Methodological Path

In view of the reflections on the particularities of university teacher education and its repercussions on the teaching of Computing through the development of computational thinking, the theoretical and methodological outline of the action-action-participatory research was defined in this study. Initially, the need for systemic actions aimed at the formation of teachers who are essential to the study of Computing in Higher Education and its various relations is understood as an assumption, since, in the studies undertaken, there is a lack of articulation between the levels and modalities of education for professional performance. As a theoretical reference for the understanding of the object of study focused on teacher training, it is initially listed a literature review on teacher training that contributes to a qualified teaching practice (IMBERNÓN, 2009, 2011, 2012; PIMENTA, 2012; PIMENTA; ANASTASIOU, 2014; ALMEIDA; PIMENTA, 2011).

In the initial contact with the empirical field, the record was made through field notes (observation) in order to understand the organizational process of the educational institution, in which the study was materialized. Field notes are understood as "the written account of what the researcher hears, sees, experiences and thinks in the course of collecting and reflecting on the data of a qualitative study" (BOGDAN; BIKLEN, 1994, p. 150). Authors Bogdan and Biklen (1994) present possibilities for organizing field notes, as they can be descriptive or reflective. The former is concerned with "capturing a word picture of the observed place, people, actions, [sic] and conversations" (BOGDAN; BIKLEN, 1994, p. 152); while the latter refers to "the part that learns more from the observer's point of view, their ideas and concerns" (BOGDAN; BIKLEN, 1994, p. 152).

In general, the research procedures used are: literature review, documental analysis, observation field notes of three classes of disciplines offered by the DCC/UFBA and the realization of trainings distributed in four meetings related to the Teaching of Computing. With this in mind, it is necessary to indicate the nature of the research and detail the procedures used for the apprehension of the object of study that we intend to investigate. Thus, we chose qualitative research with classroom observations, recorded by field notes and teacher training

offered to teachers of the Computer Science Department (DCC) of the Federal University of Bahia (UFBA).

The field notes are necessary for a better understanding of the object of study, since they can reveal or unveil what is not evident in the speeches, nor in written records (various documents). In this case, a script was prepared for the organization of records with emphasis on the aspects that need to be observed in field notes, particularly the experiences conducted in the classroom with the DCC teachers in three authorized classes.

Regarding classroom observation, Morgado's (2003) studies were used, as they present a model to analyze the practices developed in classrooms. Such model is structured in six fundamental dimensions: "planning, learning activities/tasks, organization of students' work; classroom social climate; materials and resources and assessment" (MORGADO, 2003, p. 81-82). In this study, the author (2003) also characterizes the relevance of each dimension.

The first dimension, which involves planning, refers to the organization of the work to be developed. In this case, a well-organized and structured course with well-defined steps can significantly increase the levels of success for all students. Teachers define what the student needs to learn, the conditions under which he or she will learn, how he or she will learn, and the evaluation criteria to be used. In defining learning materials and resources, these are the tools and resources that the teacher uses to support learning.

The organization of work encompasses how students are asked to organize themselves to develop learning. While the social climate of the classroom would be the privileged site of class activity, it is assumed as a primary aspect in an educational institution organization that, desirably, assumes itself as differentiated. Finally, evaluations mean all the processes involved in monitoring the teaching and learning processes, considering the procedures and mechanisms experienced in the classroom (MORGADO, 2003).

Other significant studies that are considered in this work are those developed by Altet (2017), whose teaching practices are constituted in three domains. The first refers to the relational environment, nonverbal and multimodal interactions. The second considers the teacher's pedagogical organization and management. The third deals with the didactic-epistemic management of learning and knowledge.

When conducting social research in the educational field, it was developed an "activity of successive approximation of reality that is never exhausted, making a particular combination between theory and data" (MINAYO, 2007, p. 23). In this context, the process of analysis of the data collected will be categorized, considering the specific reality and its manifestations and repercussions in the experiences of teacher training in Higher Education related to the teaching of Computing.

The reflections herein are the results of a research process composed of a qualitative approach with the use of some procedures such as: (i) field notes of the monitoring in

undergraduate classes offered by the DCC/UFBA and (ii) pedagogical training offered to the teachers of the DCC/UFBA. The analyses consider the context of undergraduate teacher training in Computing, based on a study done with professors at the DCC. Although the study was conducted in a specific reality, it can be inferred that it is consistent with the literature on the training of university professors with the definition of general hypotheses that can lead to representations of the Brazilian context.

In view of the references cited, this paper presents a reflection on the need for teacher training in Higher Education and the role of the university as the locus of this training, based on the analysis of the performance of teachers of the DCC/UFBA, who are bachelor professionals and were included in the scope of the research. Thus, in the course of the work, we seek to understand the challenges of the formation of university professors in their trajectory of performance and the decision-making processes to guarantee the quality of their profession, as well as the particularities of the pedagogical formation required by undergraduate students in Computing in a specific reality at the DCC/UFBA.

It is worth mentioning that this study received approval from the Research Ethics Committee of the UFBA School of Nursing, with the Certificate of Ethical Appraisal Presentation number: 32774219.8.0000.5531.

5 Experiences of the research process at DCC/UFBA: field notes from classroom observation and university professors' perceptions of training

According to the studies of Morgado (2003), we followed a possibility of analysis of the reality observed in a given period in the Curricular Components of Database, Artificial Intelligence and Data Structures offered by the DCC/UFBA. It is interesting to note that the classroom observations were made during a significant period of time, in order to understand the nuances of teaching Computing in Higher Education. The analyses also refer to the three constitutive domains of teaching practices delimited in studies advocated by Altet (2017) and Morgado (2003).

During the period in which the observation of classroom dynamics was carried out in the Curricular Components followed, we tried to perceive the possibilities for the teacher to demonstrate his organization of didactic-pedagogical work and of evaluation processes forwarded, among other mechanisms of classroom experiences. The observations revealed a diversity in the methods employed by the teachers and in the relationship established between them, the students, and the knowledge, but some similarities between the practices are perpetuated.

At first, it was analyzed through the field notes on the relationship with the students that those of the observed subjects managed to establish a meaningful interaction in a way that encouraged participation, favoring the social climate among them, while others presented

difficulties in establishing strategies that favored interaction with the class and the perception of the students' relationship with knowledge. Specifically, only, one of the cases observed performs pedagogical-organizational interventions and establishes a meaningful interactional climate based on dialogue (ALTET, 2017).

It was observed that the teachers monitored favor methodologies with emphasis on the exposure of scientific knowledge in the classroom. The observed reality is permeated with dialogues, but they need a stimulus, strategies, and internationalities in the process of seeking knowledge. While the dialogic nature of this approach was explored through strategies that allow the meaningful interaction of the students with knowledge, such as activities in which they performed individually and collectively on the board, questioning and various exercises, other procedural tactics for conducting the teaching and learning processes could also be used to expand the teacher's mastery and handling of the interactive process. In other words, among the teachers monitored, we observed a predominance of expository strategies, to the detriment of the evaluative process of listening that allows us to understand how the students are internalizing the knowledge and how they manage to articulate this knowledge, besides improving the social climate in the classroom.

The dialogues need a better intentionality to understand how the students have been internalizing the knowledge. The technical rationality that is demanded in Computer Science courses is noticeable, but it is necessary to reflect on this demand and the cognitive conflicts experienced during the learning process. For a greater abstraction of the students, it would be possible to elaborate simulations of the knowledge in real context situations in which they are inserted. Overall, they could promote more mechanisms to interact with students and perceive how they are internalizing the knowledge. Certainly, the systematization of content with effective pedagogical practice guidelines could have greater meaning to the student even in Higher Education.

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Regarding the planning of teaching, while all teachers presented their syllabus at the beginning of the course, only a few made this document available so that the undergraduates can continuously consult it, through the institution's platforms, or rescued it in class showing its meaning in the mobilization of learning activities. In some cases, it becomes evident in the observations, the absence of explicit contextualization of the intention of the didactic strategies adopted, such as the configuration of practical classes held in didactic laboratories. In our

observations, a significant question arises: what is the meaning of the laboratory class for the undergraduate? Certainly, the deepening of understanding the meaning of each procedure for the internalization of knowledge can promote valuable moments of achievement of the quality of the relations between knowledge between the teacher and the student. When the intentionality of the procedures does not become so expressive, it only reaches the level of technical rationality in deepening the reflections on knowledge. It is necessary, in Higher Education, the construction of a university pedagogy for the cognitive, affective-emotional, skills and attitudes development as indicated by Soares and Cunha (2010).

It is worth noting that the teacher in expository-dialoged classes has the opportunity to ask questions and use other tactics to understand how students are interacting with knowledge. Even if the class is expository, it should be dialogical and interactive, as recommended by Morgado (2003). Valuing dialog and interaction is primordial to the learning process. In some moments, this absence was felt due to the emphasis on presentation of slides without questions and interaction with the students, even to improve the social climate of the classroom.

Certainly, exploring students' cultural, affective, and cognitive structures establishes broader stimuli for learning, as proposed by Cunha (2006). Examples and activities contextualized with the concrete reality closest to the students were little explored by teachers, who rely on technical language and examples taken from textbooks and teaching materials. In this perspective, we see the influence of the belief in a false technical objectivity in the observed experiences in which the technical-scientific knowledge has meaning in itself and not constructed from its relationship with the social reality and culture of a given locality. Anchoring technical-scientific knowledge, its history, its potentialities, and the ethical issues that permeate it, in the student's living context would be an aid to the didactic-epistemic management of learning and knowledge.

Another observation refers to the use of tools with the possibility of exploring certain knowledge. We believe that by inserting a tool with new possibilities of knowledge internalization, the use of auxiliary examples, as well as moments set aside to check students' doubts, could contribute to the understanding of the platform, as well as explore its potential to systematize the concepts exposed in previous classes.

In all observed classes, the evaluation process is still centered on the exam perspective, with the development of tests to measure the knowledge internalized by the students. Little emphasis was observed on the more diverse evaluation strategies that allow the connection between the knowledge discussed in class and the previous knowledge of other subjects or even the student's own reality, considering the evaluation as a continuous activity of a mediating nature that allows us to understand how they are internalizing the knowledge. Certainly, if the students' cultural, affective, and cognitive structures were more explored, the learning stimuli could reach broader teaching and learning processes, as proposed by Cunha (2006). Some examples presented by teachers could be contextualized with the concrete reality closer to the students, would help the teaching and learning process.

The importance observed in the affective-emotional relationship established between the teacher and the students to provide a favorable environment for learning must be emphasized, even in Higher Education. The impact of these factors can be clearly observed in the monitored classes in which the professors were able to conduct their classes in a humorous way, which is reflected in higher student motivation and, consequently, higher participation. In fact, we could all reflect that the lack of student participation among other factors may be related to non-internalized knowledge, motivation, self-esteem, self-concept about their own learning.

In general, the classroom observations helped the research to understand the specificities of the knowledge and methodological strategies for the teaching of Computing in the undergraduate course. It is identified the need for teaching strategies that stimulate abstraction, pattern recognition, composition and decomposition that encourage the understanding of content and knowledge covered in the classroom, as pointed out by Wing (2006), for the development of computational thinking. One can use strategies such as unplugged computing in an initial way, or even computational tools with a clear definition of the follow-up of the stages of the learning processes of computing content. Although it is interesting to point out that computational tools need methodological guidelines. The possibilities of the diversity of methodological guidelines are highlighted by the authors Altet (2017) and Morgado (2003), who talks about the relevance of conducting methodological tactics that lead the didactic-epistemic management of learning and knowledge.

It is also observed that the university teacher needs to conduct knowledge related to the planning of teaching activities, involving the ability to outline learning objectives with reference to student behavior and not only the determination of theoretical knowledge (CUNHA, 2006). It also needs the construction of an interactive social climate among students and these with the teacher to identify prior knowledge and motivational aspects arise in the learning process itself (MORGADO, 2003; ALTET, 2017). Recognizing the relevance of interactivity as an essential mechanism for the exercise of teaching is crucial. This can reflect in the motivation for the student's conscious and voluntary involvement, even if in an initial manner so that they, even if little, understand essential aspects of their future professional performance (SOARES; CUNHA, 2010).

After the records and analysis of classroom observations in the course of the research trajectory, the need to develop a training arises, suggested in the Meeting of the Computer Science Department (DCC/UFBA). In this context, a planning begins according to themes detected in the interviews and in the classroom observations. The period set for the training was researched with the teachers of the Computer Science Department when they answered a doodle[2] sent by e-mail. Consequently, we defined four themes for the development of the training process.

[2] Online collaborative scheduling tool, available at: http://doodle.com

The first developed reflections on teaching planning and was held on May 31, 2019, in daytime hours. The menu was articulated to promote reflections on the planning of teaching and its relevance in teaching in Higher Education. Within this context, understand the necessary sequence to the teaching and learning processes, as well as methodological steps and strategies to be put into practice in the educational act. Discuss appropriate strategies for teaching with a theoretical/methodological foundation, required for the development of educational practice.

The second meeting took place on May 7, 2019, in the afternoon. The theme was about "Computational Reasoning and teaching mediation". Discussions on the development of computational reasoning in educational processes guiding teaching practice in Computing were experienced. This means inferring that teaching practice needs pedagogical, didactic, methodological, and conceptual directions in the systematization of scientific knowledge proper to Computer Science.

The third meeting took place on June 28, 2019, in the afternoon shift, with the theme "Teaching Computing and the PBL method in the teaching-learning process". The purpose was to systematize discussions about the fundamentals of the Problem-Based Learning (PBL) method as a didactic and methodological strategy to assist teaching and learning processes in Computing. It seeks to encourage the understanding of an innovative methodology that enables a pedagogical praxis capable of going beyond the limits of purely technical training to effectively achieve the development of skills and attitudes necessary for the formation of the subject.

Finally, a fourth meeting was needed to study the menus and significance of the development of specific Computing skills according to the educational objectives present in some subjects of the Computer Science Department. It was shown, in this meeting, the need for teachers to understand the need to think more about how to conduct the students' learning in different domains (**cognitive, psychomotor, and attitudes**) regarding the knowledge to be systematized according to the menus of the Computer Science subjects.

The table below shows the topics covered and the number of teachers who participated, out of a total of 44 teachers from the Department under study:

Table 1. Number of meetings, topics covered, and number of participating teachers.

MEETING	DAY 1	DAY 2	DAY 3	DAY 4
TOPIC	Reflections on Teaching Planning	Computational Reasoning and teacher mediation	Computer Science Teaching and the PBL Method in the teaching-learning process	Discussions about teaching practice
Number of Professors	05	12	06	04

Source: Prepared by the authors (2022).

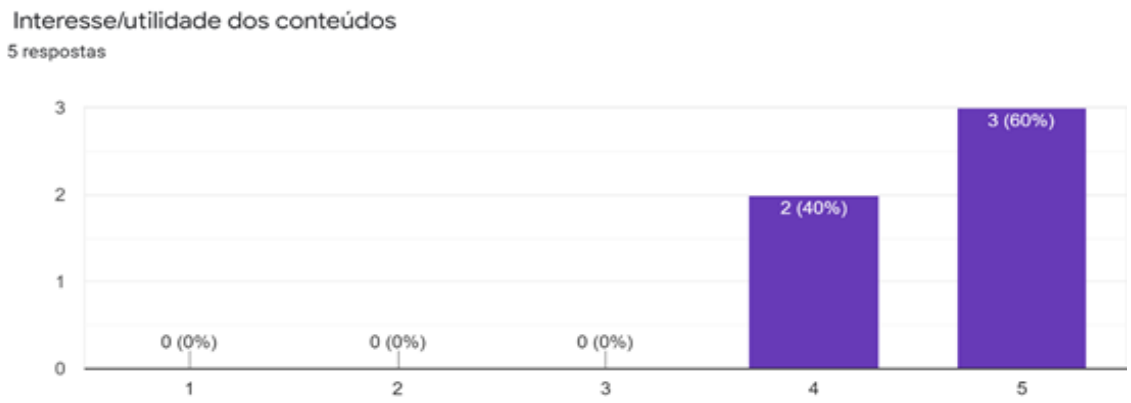
This table shows that of the 44 professors, few attended the formative meetings, and some justified themselves by referring to the diverse demands of bureaucratic-administrative activities of the university, as well as meetings and activities related to research, student orientation, among others. It was observed a higher number of teachers who attended the meeting with the topic of Computational Reasoning and Teaching Medication, in which there is a contextualization more directed to Computer Studies. This shows that many do not identify with studies related to teaching in a broader way, such as those related to education.

In this sense, the researcher reflected on the greater involvement of teachers with the theme directed towards the experiences of teaching Computing than with other dimensions of teaching practice. It is inferred that a continuing education for university professors in Computing could have greater adherence if the proposal for reflection is directed towards the problems inherent to the specific knowledge of the area. Training focused on the context of Computing knowledge articulated with other studies of university teaching practice is required to establish a more qualitative adherence with more expressive motivational aspects. There is also the challenge of overcoming the accumulation of activities required from a university professor, which are more focused on meetings and actions in research groups, and a greater conquest to participate in training processes, since it is not usual when the subject refers to didactic and pedagogical topics, as pointed out by Cunha (2006) about teaching at university.

To understand the possibilities of reaching the formative process experienced, an evaluation form was sent by e-mail to the participating teachers. This form presents a gradation in which one can register in its questions the level of satisfaction (scale between very satisfied and dissatisfied) of the participants, according to the methodology adopted.

At the time of the training experience, it was shown that the systematized contents promoted significant participation of the teachers regarding fundamental study aspects observed in several literatures and in the reality of the Computer Science Department (DCC). The level of satisfaction (according to the Likert scale) of the teachers who answered the questionnaire ranges from satisfied to very satisfied.

Graph 1. DCC professors' level of satisfaction with the interest and usefulness of content



Source: Prepared by the authors (2022).

In planning the training, there was an intense concern in the selection of studies and themes consistent with the specific reality of the Department to arouse the interest and participation of teachers in promoting a social climate that contributes to the university teaching in an effective and qualitative way, as Almeida and Pimenta (2011) point out. In this context, the teachers showed themselves, both at the time of the training and when indicated in the chart, satisfied and many satisfied with the presentation of the usefulness of the contents in reflections on their practice.

The methods used in the training transited between exposition and dialogues about scientific studies between education and computing, besides allowing an intense dialogue with questions about the practice of Computer Science teachers in the university reality. These aspects allowed a significant evaluation from the participating teachers. The level of satisfaction shows that the teachers involved noticed the articulation developed between the theoretical studies and the practical references used to promote a meaningful discussion about the university realities in the teaching actions necessary to systematize knowledge in the area of Computing.

The form provided also sought to identify aspects that were significant or limiting in the course of the educational process. The teachers' perceptions are shown below.

> [...] meaningful-the discussions, the topics; limitations-time and shift (PROF-COMPUTE 1, 2019).
>
> The sessions were aimed at presenting (and discussing) basic/fundamental topics related to teaching. This is important in itself. However, I think there is still a gap between the presentation of these concepts and their application in the classroom by faculty members. Additional sessions would certainly be needed (PROF-COMPUTE 2, 2019).
>
> It was good to hear the perceptions of colleagues and reflect on my position even after the in-class meeting (PROF-COMPUTE 3, 2019).
>
> The discussions of the topics among the participants were, for me, quite productive. I believe that two limitations of the training were the lack of a "practical moment", where we could more effectively experience some kind of methodology other than the traditional one. Another polemic point that I think could have been explored are the issues involving evaluation. My experience has been to "surrender" to the least difficult for me and to what the students prefer: tests. But I realize that this only encourages a lack of systematic study over the periods between exams. Now I also don't know if these points were addressed in the first meeting that I did not attend (PROF-COMPUTE 4, 2019).
>
> To better understand the teaching and learning process from a pedagogical point of view, in addition to getting to know new teaching and learning methodologies. There were no limitations regarding the lecture-dialog. It was well conducted and provided enough openness for all participants to interact. Perhaps a better mediation for participants who want to verbalize the course topics too much (PROF-COMPUTE 5, 2019).

The teachers' reports show the relevance of the selection of themes in the face of a previous identification of the research in observations at the DCC. It is acknowledged the

limitation of the training regarding the definition of times and shifts that would meet the needs of the DCC teachers. It is agreed with some reports that deal with the need for other meetings to experience moments to intensify discussions about learning evaluation, despite having started studies on the theme of teaching planning and its guiding aspects. It is shown the intense contribution of this moment to promote dialogue among the teachers themselves and reflection about their own practice regarding specific knowledge of Computing.

> We have observed that in life and in the university career there is a lack of systematic opportunities for personal and group growth for collective work, with intentional development of the ability to deal with the other, with diversity of thought and action, development of mediation brain processes, which include listening and analyzing before defending or attacking ideas, as well as the important distinction between the idea of the other (natural movement of disagreement, fundamental even for the growth of syntheses and the foundations of arguments) and the person of the other. And the group is also an important factor, in dealing with challenges (ANASTASIOU, 2011, p. 50).

Faced with the themes addressed in the training, we tried to identify which would have greater meaning according to the teachers' perception. Here is the description in the form:

> PBL seen interest in adopting it (PROF-COMPUTE 1, 2019).
>
> I find that the discussions about the topics (in general) during the sessions served as moments to reflect on the actions we take in the classroom (PROF-COMPUTE 2, 2019).
>
> Development of Computational Reasoning (PROF-COMPUTE 3, 2019).
>
> The topic on PBL for me was quite interesting, as it renewed in me the desire to try again to apply the methodology, in particular next semester in an elective subject, which, at first, students take because of a greater affinity to the subject (PROF-COMPUTE 4, 2019).
>
> Discussion of the theoretical and practical meaning of didactics and aspects that interfere with learning (PROF-COMPUTE 5, 2019).

In the reports, there is an emphasis on the fundamentals of the Problem-Based Learning (PBL) method. There is also a concern among teachers to understand methodologies that will qualitatively boost their teaching. Only one teacher cites the discussion on Computational Reasoning/thinking as the most significant theme of the training. Certainly, the short time of the discussion did not explore the theme in a broad way in order to implement the discussion in Higher Education.

Another theme that was mentioned by only one teacher was the didactic and pedagogical aspects of teaching practice in Higher Education. As a result, it can be seen that teachers rarely mention didactics as an essential part of their teaching. Certainly, this aspect reflects the limited experiences of discussion on the subject, and few understand its relevance in the daily reflections on university teaching practice.

In the university career, pedagogical issues inherent to the classroom are rarely discussed and, when there are opportunities, they become quite controversial, as Anastasiou

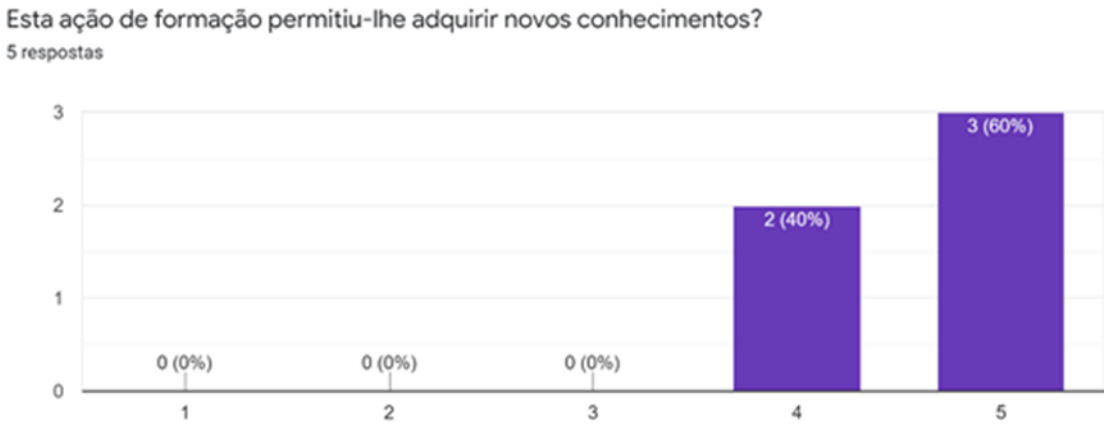
(2011) points out, due to the absence of horizontal debates on the teaching praxis, because some want the supremacy of their actions in the classroom or in other academic and scientific performances in certain areas of study. In our view, only group discussions about the challenges of university teaching could culminate in the sharing of "anguish" experienced on a daily basis and seek solutions for the quality of the teaching and learning process.

In the construction of a formative process for university professors, a welcoming attitude was adopted, as well as a favorable social climate with freedom to expose their perceptions about the daily educational act, as well as to interact with the lecturer and other colleagues. It is known that, in the university context, there are few opportunities for reflection on the educational practices of teachers themselves and of their colleagues. According to the graphical representations and the level of satisfaction about the training, it was possible to stimulate the teachers' attention and promote moments to share their daily trajectories of advances and limitations of the teaching practices to reach the students' learning, as well as didactic-methodological strategies to overcome their difficulties.

The social climate of the training was thought of from the perspective of not emphasizing the "judgment" of educational practices, but rather the sharing of university teaching performances in the DCC context. What we tried to promote in the training was a possible reflexivity for patients to analyze how they act and how they wish to act, what they do and how they do in their practices related to teaching, according to Imbernón's studies (2009). Certainly, such a direction promoted in the participants a high level of satisfaction with the training.

Another relevant aspect to be observed in the trainings would be to identify if they allowed the internalization of the new knowledge and its meaning. This questioning can be demonstrated in the following graph, using the Likert scale of satisfaction:

Graph 2. DCC teachers' level of satisfaction about the new knowledge acquired in the training



Source: Prepared by the authors (2022)

Graph 02 shows the satisfaction of those involved in understanding the quality of the objectives to be achieved in the internalization and reflection on new knowledge about

educational practice in Computing. It notes that the consulted teachers significantly evaluate the knowledge that, in the process of their teaching performance, they did not have the opportunity or encouragement to seek them, however they note that they are significant to the exercise of teaching professionalization, as Anastasiou (2011) points out.

Therefore, Graph 03 highlights the validity of the training offered to support teaching. The representation is observed, considering the Likert scale of satisfaction:

Graph 3. Level of satisfaction of the professors of the Computer Science Department about the validity of the training for their teaching action

Source: Prepared by the authors (2022).

The graphic representation shows that the participants in the training assigned meaning to the validity of the systematized knowledge and reflected on their teaching activities and the possibilities of changing them. The purpose of the training had a centrality in specific aspects of the teaching action with general discussions of education, based on methodological directions of teaching and its peculiarities in the Undergraduate Computer Science. Such specification was, we believe, the differential in the level of satisfaction of those who had the opportunity to experience those formative meetings, considering the unpredictability, uniqueness, conflict, and instability of teaching action (PIMENTA; ANASTASIOU, 2014).

Subjectively, the participants were asked which knowledge stood out in the training and made them reflect on their teaching practice, in addition to asking them to describe the aspects of the training that drew more attention to the development of their class. Below are the reports:

> Computational thinking made me reflect on what it is about; the discussions were very enriching (PROF-COMPUTE 1, 2019).
>
> I consider that the sessions brought an introduction to formalization about teaching, in the form of terms and concepts that are used to discuss and reflect on teaching practice. As commented in an item above in this form, I believe that the moments of discussions with colleagues were important moments of reflection (PROF-COMPUTE 2, 2019).

> The dialogue with colleagues, the views of colleagues. It was not a training to assimilate content per se, but to discuss our practices and how to improve them. I enjoyed it very much (PROF-COMPUTE 3, 2019).
>
> The discussions undoubtedly brought a reflection, and a certain "relief" to see the problem I face with evasion and the apparent lack of stimulation from students is not exclusive to me (PROF-COMPUTE 4, 2019).
>
> Imagining and building abstraction processes (e.g., analogies) for students to be able to understand more theoretical concepts was one of the highlights. Understanding that some methodologies I have adopted are useful in the pedagogical realm was especially important as well. Knowing more about the types of learning assessments were especially useful too, as it may come to help future teaching-pedagogical practice (PROF-COMPUTE 5, 2019).

In these records, it can be seen that, despite such a short period of time, the training caused significant repercussions. The theme of Computational Thinking, which seems to be little explored in Higher Education in the reality of the university, is highlighted in one of the speeches. The concern of one of the teachers with the issue of "dropout" can also be observed and was shared in one of the trainings. In it, the teachers discussed teaching practices that could try to overcome the insistent dropping out of students. In this context, the PBL methodology, the discussion about the development of computational thinking, among other themes, were placed as strategic possibilities for a wider reflection about practices in Higher Education in Computing. The possibilities of evaluation and its differentiation from the exam was another theme that had already been identified as relevant for teachers to reflect on the teaching and learning process.

Even with the identification of a high level of satisfaction among those involved, they were asked to point out the difficulties encountered to experience this moment of teacher training. The reports indicate:

> The shift and day of the week. I would have liked to have actively participated in all of them, because I find them all very interesting for teaching (PROF-COMPUTE 1, 2019).
>
> The sessions were quite enjoyable. There was incompatibility, however, between the time of one of the sessions and my other commitments (PROF-COMPUTE 2, 2019).
>
> None (PROF-COMPUTE 3, 2019).
>
> The greatest difficulty was not related to the content or the instructor, but rather to excessive interpersonal debates among the course participants (PROF-COMPUTE 4, 2019).

Throughout the research, a significant level of satisfaction was verified, because when the training was offered, it was previously sought to understand the wishes and the main difficulties of teachers in that specific reality. And, certainly, offering the power of speech to teachers without judging their perceptions or teaching trajectory in the absence of continuing education processes promoted a favorable climate for the internalization of a new look at specific aspects of university teaching in Computing. At certain moments, it was even embarrassing to promote the control of the speeches in the debates, as one of the participants

pointed out. We tried to enable reflective moments of the university teaching practice itself and the conditioning aspects of the teaching and learning process according to the studies of Almeida and Pimenta (2011).

The meaning of the approach adopted in the systematization of knowledge would be to take advantage of teaching practices as social practices with the use of knowledge, skills, and attitudes in combination with expectations and broader perceptions of the world, related to their histories. Even if in an initial manner, we tried to awaken in the group of participating teachers the need for training and indicate possibilities of the study of didactics in their teaching performance, as indicated by Imbernón (2012). Soares and Cunha (2010) also indicate the specificities of university professors and their training needs with valorization of their experiences and recognition of their much more specialized knowledge, even with certain didactic and pedagogical absences.

The conduction of university training in the context of this research sought to welcome and systematize didactic-pedagogical knowledge needed by those involved. In general, it was felt that there was a need for greater applicability of pedagogical practices at the very moment of training. However, this difficulty did not compromise the meaning of the training for the teachers of the Computer Science Department during the moments experienced, according to the evaluations presented.

6 Final considerations

It is observed in the course of the study that the constitution of teaching knowledge in Higher Education is an urgent need, due to the restricted experiences in the Postgraduation programs, particularly in the teaching of Computing. From the point of view of scientific contributions, this study presents a possibility of contributing to the insertion of a new look at the needs of Computer Education and the appropriation of new reflections about teaching in Higher Education.

Despite significant advances in the practice of university professors, there is still a need for greater opportunities to reflect on improvements in their teaching. These teachers need to articulate their own teaching, the relationship with the theoretical and scientific knowledge of the curricular component, and the social needs of the student's education in a broader way, considering their previous knowledge. It is shown in this research that the teachers, even with their university demands, were willing to allow an observation in the classroom and have the opportunity to reflect a little about their practice, when there was the opportunity to report aspects of their teaching and participate in the training.

In this context of university training, it is significant to establish a training centered on the context of Computer knowledge articulated with other studies of university teaching practice for more qualitative adherence with expressive motivational aspects. Still, we face the

challenge of overcoming the accumulation of activities required from a university teacher, as well as the lack of understanding of the relevance of formative processes for the improvement of teaching practice and its relationship with the knowledge of the Curricular Component itself.

In addition to a search for research teachers, professionals who have a sensitive look at the broader demands of teaching are needed, as well as educational and institutional policies that encourage university teachers to seek training that enhances the teaching in their challenging daily experiences between the conflict of teaching and the universe of research PIMENTA; ANASTASIOU, 2014).

The identification of the systemic relationship between Under graduation, Postgraduation and basic education at the DCC/UFBA was observed at specific moments in some educational practices of responsibility of those linked to research projects, extension, and the Program for Scholarship Initiation to Teaching - PIBID. It is observed that the requirements established by Law No. 11.502 (BRASIL, 2007), in articulating in a systemic way, the various levels and modalities of education are not yet implemented as they should be in Public Universities in Graduate Programs, being an individualized concern of researchers. Consequently, the DCC/UFBA follows this observation.

This horizon of reflection helps to situate the teaching of Computing and its formative needs in society not only from the discursive, rhetorical, and conceptual substrates that underlie official documents, but also in educational practices that may have feasibilities in real concreteness in the face of profound technological, social, cultural, and economic transformations.

Another significant aspect of the study presented concerns the understanding of the role of both the institutions involved in the formation of university teachers related to the teaching of Computing and the appropriation of educational technology, involving Undergraduate, Graduate, and Basic Education. In this sense, it is expected that increased studies need to be conducted with the need for the dissemination of computational thinking in Brazilian Public Education, as well as the training of university teachers in their locus of action. Therefore, teaching techniques and methodologies need to be adopted, such as: Unplugged Computing, PBL, among others for the development of computational thinking. It is worth reflecting on a broader understanding of the role of these institutions, based on a careful analysis of the political-pedagogical conceptions, due to the pertinence and social relevance of the professional training of university teachers in Brazil.

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