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## Didactic choreographies and Science education: the stage of enactment in the formative process of pedagogues

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### ABSTRACT

**Introduction:** in this study, we adopt the analogy of art and dance within the context of science education. We focus on the enactment stage, where the teacher, in the development of their teaching practice, directs efforts to provide strategies and actions aimed at enabling their students to carry out their activities, taking into account the resources, interfaces, and learning contexts. **Objective:** to analyze the enactment of content and didactic strategies of the investigated curricular component. **Methodology:** the research approach is qualitative, and in terms of research levels, it falls under the categorization of descriptive research. Regarding the techniques for data construction involving people, we utilized non-participant observation of the curricular component of Teaching Methodology and Learning in Natural Sciences I, with audio recordings of classes and records in observation diaries. all data were analyzed using the Content Analysis method. **Results:** Reflection and discussion on how to better execute the Teaching Plan of the studied curricular component, attention to the educational biography narrative regarding the teaching of Science by the students; development of the curricular component as a collective construction between the Choreographer and dancers. **Conclusion:** some danced movements performed by both the Choreographer Teacher and her student dancers appeared, in light of the analysis of the Didactic Choreographies Model, as a didactic model of organic, humanizing, flexible, and creative order to train versatile future teachers to teach Science to children, youth, and adults.

### KEYWORDS

Teacher training. Teacher training model. Undergraduate teaching.

## Coreografias didáticas e ensino de Ciências: a etapa da colocação em cena no processo formativo de pedagogos

### RESUMO

**Introdução:** adotamos, nesta pesquisa, a analogia da arte e da dança sob o contexto do ensino de ciências. E focamos na etapa da colocação em cena em que o professor, no desenvolvimento de sua prática docente, centra esforços para disponibilizar as estratégias e ações com o intuito de possibilitar os seus alunos a realizar as suas atividades, levando em consideração os recursos, interfaces e contextos de aprendizagens. **Objetivo:** analisar a colocação em cena dos conteúdos e as estratégias didáticas do componente curricular investigado. **Metodologia:** a abordagem de pesquisa é de natureza qualitativa, e em relação aos níveis de pesquisa, enquadra-se na categorização de pesquisa descritiva. Em relação às técnicas para construção de dados com pessoas, fizemos uso da observação não participante do componente curricular de Metodologia de Ensino e Aprendizagem em Ciências da Natureza I, com gravação em áudio das aulas e registros em diários de observação. Todos os dados foram analisados a partir do método de Análise de Conteúdo. **Resultados:** reflexão e discussão sobre como melhor executar o Plano de Ensino do Componente curricular estudado, atenção ao relato da biografia educacional em relação ao ensino de Ciências dos discentes; desenvolvimento do componente curricular como uma construção coletiva entre a Coreógrafa e bailarinos. **Conclusão:** alguns movimentos dançados tanto pela Professora Coreógrafa quanto os seus alunos bailarinos, apresentaram-se, à luz da análise do Modelo das Coreografias Didáticas, como um modelo didático de ordem orgânica, humanizadora, flexível e criativa para formar futuros professores polivalentes para ensinar Ciências para crianças, jovens e adultos.

### PALAVRAS-CHAVE

Formação de professores. Modelo de formação docente. Ensino de graduação.

## Coreografías Didácticas y Enseñanza de Ciencias: la etapa de la puesta en escena en el proceso formativo de pedagogos

### RESUMEN

**Introducción:** en esta investigación, adoptamos la analogía del arte y la danza en el contexto de la enseñanza de ciencias. Nos enfocamos en la etapa de la puesta en escena, en la cual el profesor, en el desarrollo de su práctica docente, concentra esfuerzos en proporcionar estrategias y acciones con el fin de permitir que sus alumnos realicen sus actividades, teniendo en cuenta los recursos, interfaces y contextos de aprendizaje. **Objetivo:** analizar la puesta en escena de los contenidos y las estrategias didácticas del componente curricular investigado. **Metodología:** el enfoque de la investigación es cualitativo, y en cuanto a los niveles de investigación, se encuadra en la categoría de investigación descriptiva. Pertinente a las técnicas para la construcción de datos con personas, se utilizó la observación no participante del componente curricular de Metodología de Enseñanza y Aprendizaje en Ciencias Naturales I, con grabaciones de audio de las clases y registros en diarios de observación. Todos los datos fueron analizados utilizando el método de Análisis de Contenido. **Resultados:** reflexión y discusión sobre cómo mejorar la ejecución del Plan de Enseñanza del Componente curricular estudiado, prestando atención al relato de la biografía educativa en relación con la enseñanza de Ciencias de los estudiantes; desarrollo del componente curricular como una construcción colectiva entre la Coreógrafa y los bailarines. **Conclusión:** algunos movimientos bailados tanto por la Profesora Coreógrafa como por sus alumnos bailarines, a la luz del análisis del Modelo de Coreografías Didácticas, se presentaron como un modelo didáctico de orden orgánico, humanizador, flexible y creativo para formar futuros profesores polivalentes para enseñar Ciencias a niños, jóvenes y adultos.

### PALABRAS CLAVE

Formación de profesores. Modelo de formación docente. Enseñanza de grado.

### CRedit

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## 1 Introduction

Consubstantiated by the arguments of Cid-Sabucedo, Pérez-Abellas and Zabalza Beraza (2009) on the need for the University, in its training purposes, to be aligned with more flexible curricular proposals, centered on student protagonism, making use of digital communication technologies, and, above all, with a teaching approach based on competencies and permanent professional training; Thus, these assumptions reverberate in the need to take on teaching from a more accessible and more artistic perspective, rather than teaching from a more inflexible and prescriptive perspective.

We can also cite the studies of Sobrinho Júnior and Mesquita (2002, p. 213) when they state that the traditional model of education is no longer adequate and no longer keeps up with the social demands of today, thus forcing the search for innovative educational methods and methodologies in the educational context.

In the field of training generalist teachers and pedagogues, who will also teach Science to children, young people, and adults, we need to look for solutions to the problem of this teacher's initial training regarding the (lack of) interest in building scientific and/or technological knowledge, as well as highlighting some particular features observed in science teaching in the early years, which is done by a multipurpose teacher with a degree in Pedagogy, with the challenge of helping the student to become part of scientific culture (Delizoicov; Slongo, 2013, Pires; Malacarne, 2018).

Understanding the complexity of the issue, we draw attention, among other things, to the training processes in universities that tend us to choose to be protected under the structure of didactic wisdom by the regulation of manuals, strategies, and systematic actions in the form of scripts on how to teach a science lesson, rather than being fascinated by the assumptions of art that allows the exploration of "new universes of colors, shapes, sounds and gestures through the limitless creation of artists from all times and places" (Loponte, 2013, p. 3).

Moreover, in a disruptive way, this context is increasingly subtly forcing teachers to reconfigure their knowledge and, consequently, to (re)understand the inevitability of working with transformations/innovations, giving prominence to this characteristically emancipatory dimension (Cunha, 2006).

This information points to the potential need to rethink new ways of teaching, notwithstanding the need to work with diverse resources and interfaces, assuming, in turn, that differentiated scripts in lesson planning can provide more critical training in the specific case of the training of pedagogues concerning the Teaching of Natural Sciences (Moran, 2015).

Furthermore, given the above, the performance of the class needs to be reorganized, especially in terms of how the teacher intends to stimulate the processes in the cognitive, behavioral, and emotional dimensions of the student, simulating an artistic performance - when the teaching action promotes transformations both in the one who makes the art/dance

(Choreographer) and in the one who participates, and also makes art, such as the dancer - with a view to their learning through multiform didactic elements that support the didactic action to be developed (Padilha; Zabalza Beraza, 2016; Strazzacappa, 2011).

In order to establish relationships and represent configurations about Didactic Choreographies, in this article, we adopt the analogy of art and dance in the context of science teaching, in the sense that the teacher is considered the Choreographer with the role of foreshadowing didactic actions with their students, in this work nicknamed dancers, in order to provide meaning and significance in the performance of this student/dancer, who, in turn, must present themselves as an active dancer, aware of their learning and their way of learning (Padilha, 2019).

Moreover, in the rhythm of this structure, bringing artistic elements to this research, we see art and dance as an existing and possible interaction of the elements of the didactic situation: the rhythm of the dance, metrics, and musical sequence, as the most convenient moment to put into practice and accompany specific didactic strategies (Silva, 2012) and the melody as being the programmatic content/theme to be addressed in class (Silva, 2020, p. 26).

As an opportunity, we present the objective of this article, which is to analyze the content and didactic strategies of the curricular component Teaching and Learning Methodology in Natural Sciences I, which is part of the curriculum of the initial training course in pedagogy at a federal public university located in Recife, Pernambuco. We want to point out that this excerpt from a thesis defended in the second semester of 2023 covered all the elements provided for in the Model of Didactic Choreographies.

It is worth noting that, from the macro perspective of the thesis, the main objective was to analyze the movements made by the teacher trainer and undergraduate students based on the elements of the Model of Didactic Choreographies in the curricular component Methodology of Teaching and Learning of Natural Sciences I in the Pedagogy Degree Course.

To understand the assumptions of the Model of Didactic Choreographies and our specific objectives, we defined: [i] for the first element of the model, to describe how the anticipation of the teacher/choreographer occurs in the planning of his lesson in the curricular component of Teaching and Learning Methodology of the Natural Sciences I; [ii] for the second and third elements, to analyze the placement of the contents and didactic strategies of the curricular component under investigation, above all by identifying the basic models of learning performed in the choreography proposed in the classroom scenario; and [iii] for the last element, to understand the relationships between the teacher's expectation of the product of student learning and the product of learning from the student's perspective.

## 2 Teaching practices and Science teaching

As mentioned above, science teaching should be based on principles that link the student's daily life to the content to be developed in the classroom to make sense to the student and, consequently, have meaning in their training; in the case of this article, meaningful training for science educators.

Authors such as Pozo and Gómez Crespo (2009) and Delizoicov and Slongo (2013) have already pointed out and discussed the crisis in science education, which can be seen in the apparent lack of interest on the part of students and the actual difficulty in learning Science, as well as in the curriculum, which has changed very little and is out of step with the students' training demands.

Sometimes, what students have been taught and learned dissolves quickly, especially when they are asked to apply their new knowledge to a new problem or contingency.

Given this, we have seen in many studies that deal with the subject of teaching modalities in Science at various levels of education an inevitable need/imposition for teachers to use innovative teaching models without at least having a certification that this same teacher has the conditions, appropriation, and resources to carry out their practice under these much sought-after aspects (Dias; Lira, 2017).

[...] In fact, as a result of the teaching they receive, students adopt attitudes that are inappropriate or even incompatible with the aims of Science itself, which translates mainly into a lack of motivation or interest in learning this subject, as well as little appreciation of their knowledge [...] (Pozo; Gómez Crespo, 2009, p. 17).

In turn, when we deepen our awareness and discernment about teaching and learning processes, we broaden our knowledge that Science is a process - due to issues of its historical-cultural nature, aligning and relating to technological aspects, scientific development and social organization, showing "[...] science's commitment to society, rather than the neutrality and objectivity of the supposedly positive knowledge of science" (Pozo; Gómez Crespo, 2009, p. 2) and not a volume of theories or models that should be presented to students as definitive and finished knowledge.

In the same direction, Delizoicov, Angotti, and Pernambuco (2007, p. 34) reveal that teaching action should seek to build on what is understood about the process of constructing knowledge, in our case, why and what to teach, to provide all those involved in the training process with the possibility of critically appropriating the incorporation of social representations of Science and Technology into their teaching activities.

We then discussed the construct of Didactic Choreographies, thus understanding their format, concept, and unique characteristics, which aroused our interest in analyzing them in the light of the initial training of science educators.

### 3 Didactic choreographies

When it comes to elucidations on the concept of didactic choreographies, it is necessary and valuable to present the postulates proposed by Oser and Baeriswyl (2001), who sought, through the analogy of the world of art and dance, a way to visualize the interconnection between teaching and learning and understand the complexity of the dynamic and authentic interactions that take place in the classroom, thus defining the concept called *Teaching Choreographies*, and called by Zabalza Beraza (2006, 2017) as Didactic Choreographies.

That said, when we approach the concept of Didactic Choreographies, we first need to understand the breaking down of the boundaries of the concepts of teaching and learning, considering that didactic situations can be made up of different scenarios, and these scenarios can (and should) be integrated with digital communication technologies, in turn extrapolating the walls of the classroom (Padilha; Zabalza Beraza; Souza, 2017).

Alternatively, instead, we can treat Didactic Choreographies as a semantic update that leads us to observe a new look at teaching, teaching linked to context, and this leads us to a new definition of the teacher's role in what they need to do (Baeriswyl, 2012).

We emphasize that the student's learning processes are strongly related to the teachers' teaching methods (Zabalza Beraza, 2005, 2006). Therefore, it is permissible to think that the teaching and learning relationship, in this case, is interrelated with the dance setting and that the teacher is considered the Choreographer who outlines the steps of this dance (learning stages) and that these dance stages will be moved by the dancers (students), according to the skills and artistic elements available to perform the show (the didactic situation), in addition to developing their capacities.

Oser and Baeriswyl (2001) presented *Teaching Choreographies*, as mentioned above, and Zabalza (2005) called them Didactic Choreographies. We can note here that, analyzing the analogy of dance through Didactic Choreographies, the teachers/choreographers and the students/dancers organize themselves and participate in a choreography outlined by the teacher on a presentation stage (classroom context, whether face-to-face or virtual) to set the scene of the anticipated didactic situations and, consequently, for the students to be able to "develop their steps towards their learning" (Rosa; Orey, 2017, p. 439).

Thus, under the Didactic Choreographies model, we can again envision higher education as a rich and heterogeneous set of scenarios for individuals to maximize their abilities (Zabalza Beraza; Zabalza Cerdeiriña, 2019).

The theory proposed by Oser and Baeriswyl (2001) highlights that school learning is based on a choreography that relates freedom of method, choice of social form, and situated improvisation, all three elements combined with rigor concerning the steps to be followed, which are necessary for learning a particular curricular activity (Rosa; Orey, 2017, p.439).

The bases of components on which the concept of the Didactic Choreographies



didactic model is based are described below:

[i] Anticipation or planning: It is the first element of the model and corresponds to planning. In anticipation, the teacher surveys their students' learning expectations. In this first stage, teachers select the syllabus that will be covered and how it will be worked on, outline the didactic objectives based on the regulations of the syllabus, the Course Pedagogical Project and the competencies provided for in official training documents, and the curricular activities they deem relevant to encourage student learning.

[ii] Setting the scene or Process I: We can consider it an external and visible component of the didactic choreography, which refers to teaching practice and mediation. At this stage, the teacher, in developing their teaching practice, focuses on providing strategies and actions to enable their students to carry out their activities, considering the resources, interfaces, and learning contexts.

In the same vein, setting the scene is the component in which students and teachers become protagonists by making use of resources in the didactic context since teachers need to constantly monitor themselves "in order to offer support to students without, however, restraining their steps" (Padilla; Zabalza Beraza, 2016, p. 842). In other words, this second category refers to the visible dimension of the teacher's actual planning for a subject (Oser; Baeriswyl, 2001).

[iii] Process II or Learning Base Model: It is considered the non-visible component of the didactic choreography since it shapes "[...] the sequence of mental operations or performances that the student mobilizes in order to learn" (Padilla; Zabalza Beraza, 2016, p. 843).

Following this line of reasoning, this assertion is closely linked to students' metacognitive operations, which are "facilitated by the way teachers set the scene" (Rosa; Orey, 2017, p. 441). This means that each student generates his or her choreography, which is now called learning choreography, based on the teacher's didactic proposal.

In this sense, the teacher needs to understand the phases that make up this process so that it is possible to provide the conditions for the operations necessary for learning to be activated by the students.

[iv] The product of student learning: In the Didactic Choreography teaching model, the product of learning is a visible and external component, which is the result of a succession of mental or practical operations carried out by the students, and these actions lead to effective and meaningful learning for the student.

## 4 Methodology

Again, this article, which we present here, discusses and equalizes the element of the Teacher Choreographer's scene setting. It is, therefore, an excerpt from a more extensive study that aimed to analyze the movements made by the teacher trainer and undergraduate students based on the four elements of the Model of Didactic Choreographies (anticipation, setting the scene, basic learning models, and learning product) in the curricular component Methodology of Teaching and Learning of Natural Sciences I in the Pedagogy Degree Course.

For this article, the research approach is characterized by qualitative research. This type of research approach is becoming an increasingly common strategy in the humanities and social sciences, as the assumptions of flexibility that can be carried out during the investigation and the role assumed by the researcher in defining the path/route that the research will take are requirements that are truly valued in the teaching and learning relationship of this research (Merriam, 1999; Triviños, 2009).

Given the classification supported by Gil (2008) concerning the levels of research, this article falls into the category of descriptive research. In terms of the means of carrying out the proposed investigation, this study falls into the category of field research.

These elements of methodological configuration must be intelligently integrated with the techniques we use to construct data with people, such as non-participant observation.

Next, we will talk about non-participant observation, the use of which in this work arises from the need to analyze how the content and didactic strategies of the curricular component under investigation are put into practice, above all by identifying the basic learning models used in the choreography proposed in the classroom scenario.

What is important to emphasize is that, in this study, in order for observation to be conceived as a valid instrument (guaranteeing its scientificity), careful study planning and delimitation of the field of study was carried out - the Pedagogy Degree Course and the teacher who teaches the curricular component Teaching and Learning Methodology in Natural Sciences I, considering the Didactic Choreography Model.

In this way, we carried out a controlled observation based on the proposed objective by accepting and signing the Informed Consent Form (ICF) signed by all the participants in the research (Teacher Choreographer and student dancers). Furthermore, this study was approved by the Research Ethics Committee.

The elements that underpinned the planning of the observation technique were: [i] the subjects observed, who are the teacher trainer and the students regularly enrolled in the curricular component studied; [ii] the setting is the daily context in the classroom; and [iii] social behavior. The classes took place from November 7, 2022, to April 5, 2023, and were

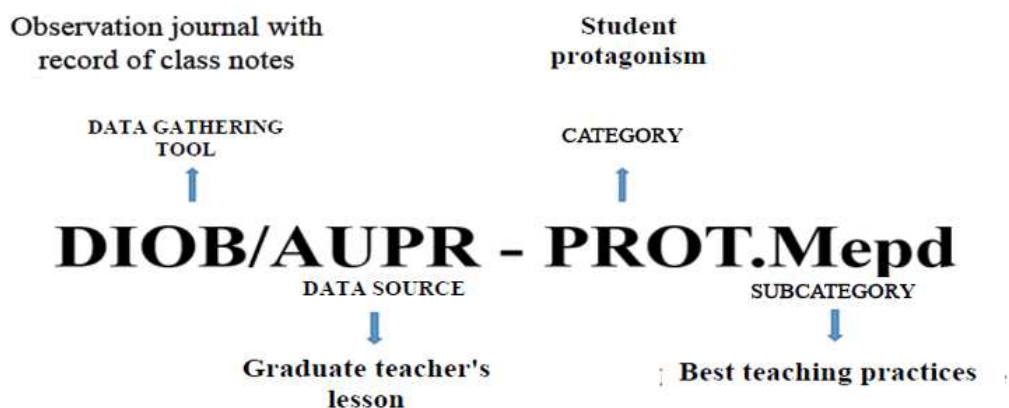


audio recorded for later de-recording and confirmation of the observation notes.

Regarding the method of analyzing the records resulting from non-participant observation, we used Content Analysis as the central motto for treating the data in this research, using the technique of thematic or categorical analysis, whose characteristic is to seek the nuclear basis of the meanings from the categorization of the data, respecting the three essential phases that are [i] pre-analysis, [ii] exploration of the material and [iii] treatment of the results, inference and interpretation (Bardin, 2016).

This study's categorization and coding scheme follow the sequence exemplified in Figure 1. In this case, in the schematic organization of the categories of the analysis of the Scene-setting stage of the curricular component of Teaching and Learning Methodology in Natural Sciences I followed the following determinations:

**Figure 1.** Categorization and coding of Scene Setting.



Source: Prepared by the authors (2023)

- The first code refers to the type of data collection and is expressed with all capital letters;
- The subsequent code mentions the data source and is also presented in capital letters, except when dealing with undergraduates, whose full codenames will be given at their request.
- Categories are shown in all capital letters;
- The first subcategories are shown with the first letter capitalized and the other letters lower case;
- The other subcategories, if any, are presented in all lowercase letters.

## 5 Getting to know the choreographer and her dancers

We need to bring the light to highlight the great participants in this precious dance of teaching and learning, whose steps demand movements from the teacher and those who are the

learners, or rather, as we will deal with here in this article: movements from the Teacher Choreographer and her student dancers.

The Professor Choreographer currently holds the rank of Full Professor at the University. She has a degree in Veterinary Medicine and teaches Didactics, Supervised Internships, and Teaching and Learning Methodology in the Natural Sciences I and II.

The dancers are students regularly enrolled in the curricular component of Teaching and Learning Methodology in Natural Sciences I (TLMNS I) in the Pedagogy Degree Course, who suggested that they be named after dances and are thus portrayed in this article, according to Chart 1.

**Table 1.** TLMNS student dancers I.

Research participants - Dancers	Justification for choosing dance
Forró	I was introduced to the world of forró from a very young age. It is a dance and rhythm that I have much affection for. That is why I chose it!
Jazz	I like this kind of dance.
Contemporary Dance	I have already taken contemporary dance classes at the João Pernambuco Municipal School.
Country	No justification.
Zumba	I already practice it, and it is becoming more common today.
Flamenco	No justification.
Samba	I like Samba.
Stiletto	It is a very imposing type of dance. It is about self-confidence and liberation, which is how I usually lead my academic (and personal) life. I often go through unpleasant situations in other areas of my life and focus my energy on areas I know I can handle. It helps me channel my self-confidence. If I am not doing well in a specific area of my life, I accept my weakness and do my best in another area, which helps me regain my self-esteem.
Xaxado	No justification.
Bolero	No justification.
Tap dancing	It suits my personality.
Belly dancing	It is an uncommon dance in our culture, giving it an air of exclusivity. It is sensual, and the clothes worn are stunning.
Street Dance	It is the one I am closest to.
Tango	No justification.
Batucalê	No justification.
Classical Ballet	No justification.
Coco de Roda	For the beauty of the movements.
Frevo	Being from the Northeast, the dance is in my heart!
Zouk	The steps and movements are subtle and detailed, usually danced as a couple, reinforcing the importance of energy, cooperation, and collective trust. I have already taken Zouk lessons.

Source: Prepared by the authors (2023).

We continue by putting the Choreographer and her dancers on the scene.

## 6 Analysis of the setting of the scene of the contents and didactic strategies of teaching and learning methodology in Natural Sciences I

When dealing with the second component of the Didactic Choreography Model, scene setting or Process I as the moment in which the teachers/choreographers use resources and organize how the conjunctures that make up the teaching process will take place, the actions and relationships of the didactic situation that will be put into practice. The categories and subcategories that emerged from the observation diaries are shown in Table 2.

**Table 2.** Categories and subcategories used in the analysis of the TLMNS I setting scene stage

Data collection strategy/data source	Category	Subcategory	Coding
Observation Diary with a record of lesson notes (DIOB)/ Teacher Trainer's Lesson (AUPR)	Science Teaching Assumptions	Structural Content	DIOB/AUPR - PENC.Cest
	Protagonism	Learning styles	DIOB/AUPR - PROT.Esap
		Mediation	DIOB/AUPR - PROT.Prme
		Best Teaching Practices	DIOB/AUPR - PROT.Mepd
	Skills and Competencies	Heterogeneity	DIOB/AUPR - HACO.Hete
		Diversity Skills	DIOB/AUPR - HACO.Codi
	Interesting lessons	Creativity and Imagination	DIOB/AUPR - PEDG.Fmdc
	Problem-based learning	Viruses, Fungi and Bacteria in Science class	DIOB/AUPR - APBP. Pecc

Source: Prepared by the authors (2023).

At the start of the semester, the teacher/choreographer proposed to the class that they discuss and reflect on the teaching plan for the curricular component Teaching and Learning Methodology in Natural Sciences I, the primary purpose of which is to integrate it directly with another curricular component called PEPE V - Prática Educacional Pesquisa e Extensão Educational (Practice, Research, and Extension) from the fifth term; on the premise of guaranteeing pedagogical practice as a curricular component, as well as ensuring the issue of

interdisciplinarity, which is present in the curricular guidelines as well as in the Pedagogical Project of the Course.

The students/dancers were arranged around the room in a circular format. As a round table experience, they were asked by the choreographer/teacher to relate their previous experiences (from primary and secondary school) as students of science content and what they thought the best science teaching practices were.

In summary, all those present pointed out that, in primary and secondary school, teachers used textbooks exclusively, encouraging only the memorization of biology, chemistry, and physics content. To the same extent, the students also reported that, most likely, the best way to teach Science to children is by bringing in a playful perspective, linking the concepts and facts of a science topic to lighter experiences, linked to games and play, such as: making models, a school garden, visits to the Science Space and activities carried out with the student's families.

In week 2, the Teacher/Choreographer begins her appearance on the scene by reporting on her experience as a teacher of the Didactics curricular component and on how this experience is projected into Teaching Methodology for Natural Sciences in terms of defining the objectives of each lesson; in addition to reinforcing the character of collective construction that the curricular component studied in this article took on throughout the semester.

The students were asked to form groups to talk about their initial conceptions of Science, scientific knowledge, and aspects of science teaching.

After probing the conceptions of Science from the dancers' perspective, the principles of Science that deal with the issues of non-neutrality, transience, refutability, complexity, and a systemic vision were highlighted. After reading the concepts of the principles recorded together, a question was put to the class about how these principles could be worked on in the classroom, with students from the Early Years and Educação para Jovens e Adultos [Youth and Adult Education] (EJA), to dispel the scientific denialism that has become entrenched in recent years.

In week 3, with the topic of discussion on Science as a human activity, the Teacher/Choreographer begins the class by explaining the books (and indicating readings) that have helped her in her training as a teacher and that these resources can help those undergraduates in their training trajectory. The subject was then explained using a *PowerPoint* projection of the principles of Science as a reprise of the previous lesson to establish whether the concepts and principles explained earlier had been understood.

This information must be intelligently integrated with the Choreographer, emphasizing to her dancers the need and importance of teaching science by enchanting everyone who is part of the school community, specifically the triad of teachers, pupils, and school.

Once again, on the classroom stage, the Choreographer invites everyone to read the text together: What is scientific (I)? by Rubem Alves, and as a result of this reading together, questions about epistemological obstacles and complexity (and what each of these terms would be) were quickly presented and explained by the Choreographer, and there was no interest on the part of the dancers in extending discussions on their subject and its relationship with their future teaching practice.

The focus of week 3 led to a second lesson on the theme of Didactics for meaningful learning in Science. In the wake of the observations evoked in this week's didactic situation, all the students were invited to consider didactics. We noticed that these dancers' contributions stemmed from their experiences in their respective internships, previous knowledge, and past experiences with teachers, as well as their best practices.

With the idea of protagonism raised in the classroom, we realized that the students in the didactic situation expected the Choreographer to provide tips on acting with protagonism. Some even pointed out how to teach Science, which had yet to be met *a priori* since, in the words of the teacher trainer.

[...] the teacher needs to find their style, based on their learning style (DIOB/AUPR - PROT.Esap), their mediation style, all of which should be linked to the teacher's research, to the study of the content that should be worked on based on the BNCC, the school's PPP, the federal and state guidelines (DIOB/AUPR - PROT.Prme). All this added to your style, your characteristics, and remembering the practices of the best teachers who have been through your training process since you started studying, as you mentioned in our first class (DIOB/AUPR - PROT.Mepd).

The point of consistency for carrying out the Choreographer's efforts for her class on didactics for meaningful learning in Science goes through reflections on Science for All, especially on teaching Science in non-formal environments.

In this orientation, both the Choreographer and the dancers sought to discuss some structuring principles of science didactics, providing information so that it would be possible to recognize the social and individual value of the construction of knowledge. They emphasized the importance of school knowledge about the sense organs, the global planet, energy, plants and animals, the air and its properties, which are helpful for human existence and for exercising citizenship, so strongly envisioned by the Diretrizes Curriculares Nacionais [National Curriculum Guidelines](DCN), Base Nacional Comum Curricular [the National Common Curriculum Base](BNCC) and Projeto Pedagógico de Curso [the Course Pedagogical Project] (PPC of the course).

Some of the contributions of educating to think were presented to the dancers in the classroom with great intensity and included the following points highlighted by the Choreographer: [i] guidelines from the BNCC; [ii] the school's PPC; [iii] the importance of the tripod that is made up of prior knowledge/knowledge, technical content and appropriate methodologies that are participatory, [iv] mobilization of teaching skills for teaching by thinking; [v] actions of investigations, problematizations and experimentation; [vi] practices outside the institution/classroom/school; [vii] relating science teaching to other areas such as

history, sociology, mathematics, physics, biology, Portuguese language; [viii] relating Science to technology and society; [ix] promoting the use of argumentation and listening; [x] valuing curiosity and imagination, encouraging the scientific spirit in students; [xi] protagonism and creativity in the didactic approach, bringing resources and proposing actions that highlight identity as a teacher.

Despite these didactic situations that are part of the training process for science educators, we entered the fourth week of the curricular component. The proposed scenario began with clarifications and guidelines for carrying out a field activity whose scenario for appreciation and construction of a proposal for hypothetical didactic situations was an audience of children in kindergarten, the Early Years, or the EJA. It was considered that this external activity had to be carried out in a group and that the setting to be explored would be the university campus that hosts the course investigated in this article.

These guidelines for carrying out the external activity led the class to introduce themselves to the specific theme of the lesson, which was - Teaching for learning by thinking - bringing up the concepts of skills and competencies and that you cannot think of a school without considering what is diverse and heterogeneous. Thus, we take note of a speech by the Teacher/Choreographer who mentioned "[...] the heterogeneity, diversity and all the capillarity that exists in modern society, in all places, developed or not, does not allow us to think of a school without these concepts (DIOB/AUPR - HACO.Hete)", because the PPC and other planning require, within all this diversity, pedagogies that fit the different ways people learn, and this we must take into account when teaching Science.

Continuing the Choreographer's speech, she argues with her dancers that it is necessary to "[...] Pay attention to what is diverse, that people have different ways of learning, and how are we going to achieve this? Here, for example, we have you, and everyone has their way of learning" (DIOB/AUPR - HACO.Codi).

The theme of Educating for learning by thinking resulted in discussions about the principles and challenges of the didactic approach so that the students who will be under the mediation of the pedagogues (who are in the process of formation and who are the social actors in this research), learn Science by thinking and mobilizing their entire cognitive structure. On the classroom stage, the proposed dance highlighted the pedagogue's role as a mediator, with a generalist education and no pretensions to delve deeper.

In this panorama, the Choreographer presents the recommendations of the BNCC for science teaching, which frame teaching thinking for learning about ecology. Moreover, within the ambiance of this theme, for example, the student/dancer must develop means for their (future) students to understand the concepts in the context in which they live and incorporate the repercussions of environmental awareness for the planet's fate.

Following on from the second lesson of week 4, with a focus on discussing Scientific Literacy - SL, all the social actors involved in the didactic situation recognized that SL provides



access to knowledge that is enlightening and liberating and that aims to train students as social agents and critical and creative subjects, since it allows science knowledge to be adapted to everyday life to improve living conditions (Cachapuz *et al.*, 2005).

However, in this particular class, although the Choreographer proposed a joint performance with the dancers, they took the position of receiving commands to perform the steps that would show them how to be scientifically literate, or rather, how to promote scientific literacy for children and/or students in the EJA.

Faced with what had been observed, the first six weeks were substantially guided by the expository approach, as categorized by Pozo and Gómez Crespo (2009). We found that the teacher/choreographer needed to organize his classes to exploit the students' previous knowledge and integrate it into the proposed objectives based on a definition of what they needed to learn from the teacher's perspective of anticipation. In other words, the presentations made in class had to be efficient in order to stimulate discovery.

For this same approach, the resources used in the block of these first four weeks were multiple. They requested prior readings of the texts made available on the *WhatsApp* application station, intending to carry out the Inverted Classroom methodology and discussions/rounds of dialog arising from excerpts of concepts, principles, and thoughts of scientific authorities in Science and Science Teaching.

The students/dancers, although they were participative and contributed with insertions during the class and the Choreographer's effort to propose teaching by discovery approach (Pozo; Gómez Crespo, 2009), the interaction promoted and carried out in the classroom setting was not conducive to any discovery or new fact, and the dynamic moments of these class meetings in the classroom setting were configured as a dynamic moment of questions and answers; answers that needed to be based on previous knowledge of the participants in that didactic situation.

Therefore, in this first block, the Choreographer and dancers' scene setting was traced by linking the dancers' everyday knowledge to the scientific knowledge of the principles of the Philosophy of Science and the History of Science.

When the second block of the TLMNS I curricular component's syllabus began, week 7, after the Christmas recess that the University had regulated in its academic calendar, the movements proposed by the Choreographer were to launch, first in the *WhatsApp* group, two critical-reflective questions to be discussed *a posteriori* about the end-of-year celebrations and the academic recess, especially about how these events could be worked on in the classroom by pedagogues.

Firstly, the speeches recounted the experiences of the undergraduates from December 2022 to January 2023. Forró, Contemporary Dance, Flamenco, Stiletto, Tap, and Tango presented their speeches discussing their intentions in teaching to work on the media issue of

the climate during the Christmas period, which does not provide correct information on the issue of snow in Brazil (and in the Northeast of Brazil specifically).

Zumba added that fireworks could be the subject of lectures on chemistry, as well as environmental education in terms of the waste left behind in the places where they are burned and the noise pollution they cause. He also mentioned that it might be possible to carry out an activity that includes debates on raising awareness of animal rights.

Bolero and Samba then pointed to the beach as a topic for science lessons and that the issue of littering could be discussed due to the lack of awareness among the population on regular days and, above all, the situation of littering during the festive season. This dancer thought of a guided activity with students and added the theme of the life cycle of turtles and how garbage can disrupt the ordinary course for maintaining the survival of these animals.

Belly Dancing, Street Dancing, and Xaxado, when talking about their experiences outside the classroom, thought they could carry out these experiences with classes of children, young people, and adults, such as the book club.

Country mentioned bringing into the discussion and contextualizing our current reality, our current problems (political and social) in science teaching, for Early Years and EJA, with the advent of the situation of the *Yanomami* Indians of Brazil, to understand why they are starving in a tropical forest biome and the biological and social impact of illegal mining in demarcated areas protected by the Union. Finally, Jazz said it developed a scientific literacy project with robotics students during university break.

Next, we will take a closer look at week 8, which focused on establishing a directed study of the carnival festivities, how these festivities can be associated with didactic resources for teaching Science, and how trainee educators can use these popular festivities as didactic/pedagogical support in their classes for children in the Early Years and students in Youth and Adult Education.

This question was presented to the dancers before the institution's academic recess and reinforced on the class *WhatsApp* station, in the same way as the question about the end-of-year parties and recess as teaching resources, and with the break in face-to-face classes, resuming at the beginning of February 2023, the dancers were able to take a more critical look at the points that the Choreographer highlighted for prior research.

Once they were in the classroom, the activity developed on carnival celebrations, as a possibility of association with science teaching, led to the Choreographer setting the scene and combining the use of the didactic strategy of directed study to allow the dancers to act independently in their interactions in the classroom; and thus making it possible to develop skills autonomously and creatively on developing the theme of Carnival as a backdrop for a science lesson for children, young people, and adults.

As well as allowing prior research on issues with the themes raised and in the classroom, such as: heat and thermal sensation, healthy eating, the body and its care, recycling, water consumption, and supply problems in cities that are the center of carnival festivities, environmental education and the chemistry of cosmetics.

Furthermore, in the research on these topics, a discussion was opened to reflect on the creative development of the dancers in this activity and how they had the freedom to think about how they could teach Science. In the same way, the Choreographer could reflect on the strengths, difficulties, and progress made in teaching her subject by observing the performance of each of her dancers in that didactic situation.

These points were observed when TLMNS I was put on stage and aligned with what Libâneo (1994) says when discussing directed study as a didactic strategy in higher education.

Continuing this descriptive look at what happened when the themes of week eight were put on stage, we mention the objectives proposed by the Choreographer when she introduced the discussion about viruses based on science education and contextualization with the COVID-19 pandemic in Brazil and around the world.

The entire lesson was based on the class's conceptions of the virus, with the choreographic objective of building a contextualized pedagogical practice based on the cross-cutting theme of health and understanding the didactic transposition of Science in the context of the school and outside the school. After a few collaborations with the dancers, she raises a question about the difficulties a pedagogue might have in discussing subjects like viruses, bacteria, and fungi with their students.

The dancers contributed to the discussion by saying that the most significant difficulty in teaching children is working with abstract concepts or elements that we cannot see, specifically chemistry and physics and that there is a legitimate need to prepare better without resorting to survival didactics in these subjects that are left out of the initial training process.

The whole class emphasized the importance of teaching Science under the assumption that Science is for everyone. The Choreographer corroborated this aspect, stressing that the students should take what they learn home into their daily lives.

Starting the tenth week and being self-coherent in encompassing and giving continuity to the same frame of reference dealt with in the previous week, the Choreographer discusses presenting the perspective of the world plagued by microorganisms such as bacteria and fungi.

To this end, it explains the objectives that were planned in its anticipation, which are: [i] to understand the importance of knowledge about microorganisms in the cross-cutting theme of health; [ii] to identify some characteristics of bacteria and fungi, as well as their relationship with some didactic strategies for meaningful learning; [iii] to carry out didactic transposition for various levels of schooling.

At the beginning of the lesson, a group of dancers mentions the excellent opportunity to work with students on oral hygiene and other hygiene habits when discussing health versus bacteria, fungi, and viruses.

We can see the Choreographer's growing concern to make it clear to her class that it is indispensable for future teachers not to be trapped by massified and plastered scripts, that teaching enables them to develop their didactics (which are in training), a didactic approach that arises from their experiences, their knowledge of the contents of the class, contents for contextualization.

Moreover, even if textbooks continue to be an essential tool for teachers, underpinning their teaching work, they should not be the only source for their science lessons.

These assertions confirm that science teaching should not be based solely on conceptual content. Once again, the Choreographer reiterates that the teaching of science that pedagogues should be based on is global, systemic, and planetary contextualization.

Moreover, this fact suggests that teachers should start rethinking their role as educators. Instead of transmitting ideas and information, they should take on the role of development agent.

The point of continuity for training future generalist teachers for science teaching was followed by discussions on a cross-cutting theme relevant to the BNCC: the environment. In this didactic situation, the Choreographer set out to put content on stage to enable the dancers to understand science teaching as a training proposal for environmental awareness.

[...] In this class, we experienced some structuring content on topics such as biodiversity, ecology, ecosystems, agroecology, and systemic vision. We highlight the need for teacher training to build knowledge of the environment, environmental awareness, and environmental policy, as well as initial and continuing training for pedagogy teachers who teach Science (DIOB/AUPR - PENC.Cest).

To establish relationships and constitute significant configurations in the training process for science teaching pedagogues in Teaching and Learning Methodology in Natural Sciences I, the Choreographer ends the theoretical block with the presentation of the theme on the function and social relevance of science teaching.

In order to do this, it is crucial to revisit the content developed throughout the semester, always focusing on the need to discuss and add to pedagogical practice a collective work that must associate school content with the student's life/reality, because it is necessary to "[...] strive to use imagination and creative processes with interesting lessons for school learning and life" (DIOB/AUPR - PEDG.Fmdc).

The dancers' role in this scenario was listening, followed by comments on their experiences teaching Science, such as using playful experiments, requesting activities that

require family participation and accompaniment, and using images and videos in science classes.

Within this work proposal, the Choreographer proposed this movement to provide her dancers with an opportunity to foster maturation, especially the ability for autonomous learning, teamwork, and critical and creative thinking, as she recorded in class: "this activity, first we had a retake of the contents about viruses, about bacteria and fungi, right? Furthermore, having gathered information on what is already known about this issue, we will work on these problems." (DIOB/AUPR - APBP. Pecc).

In the substratum of the didactic situations of Teaching and Learning Methodology in Natural Sciences I in the undergraduate course studied, we were able to appreciate each week and each thematic unit, from the audience's point of view, various scenes that permeated expository classes about teaching, didactics, teaching Science and learning science.

We saw dialogue circles requiring all participants to revisit their previous knowledge and prepare in advance for subsequent classes, directed studies, demonstrations of elements of nature as a way of sensitizing the dancers, bringing to life elements that were/are sometimes abstract or present in the field of these dancers' ideas; as well as putting the problem-based learning (PBL) methodology into context with the reality of fungi, bacteria and viruses in Science Teaching and how these future teachers could succeed with these themes in their classes.

We would emphasize that the fundamental characteristics of the curricular component of Teaching and Learning Methodology in Natural Sciences I, in terms of the scenarios of the movements observed, were: the official classroom space, the *Whatsapp* station for the rapid flow of content, teaching materials to enable the Inverted Classroom and *a posteriori* reflections on the classes and the university space that served as a source of contemplation for the development of some of the activities developed.

## 7 Conclusions

The movements performed on stage began with a proposal that allowed the student dancers and the Teacher Choreographer a moment to get to know each other, connect, and make the classroom setting a comfortable, safe, and inspiring space for everyone's development and participation throughout the semester.

In addition to reinforcing the Choreographer's intrinsic relationship with the dancers, the teacher was concerned with materializing her genuine teaching intentions with the Pedagogy undergraduates' participation, involvement, and interaction to reverberate an ethical perspective involving empathy and respect for the student's knowledge about Science.

Furthermore, in this same vein, even before developing the syllabus set out in the Teaching Plan, the Choreographer tried to discover the dancers' previous conceptions of Science and Science Teaching.

The announcement of these principles for Science Teaching supported the introduction of lectures in the first block of the semester, whose themes included Science as a human construction, Teaching for learning by thinking, and didactics for meaningful learning in Science, among other themes that permeate didactics, teaching methodologies and the Foundations of the Philosophy of Science.

In the second block, we find more direct activities for science content with directed studies, sensitive experience for drawing up lesson plans, didactic methodologies such as the Inverted Classroom, bringing up the discussion of the end-of-year celebrations and Carnival as themes for developing didactic resources for teaching Science (in Early Childhood Education, Early Years of Primary Education and Youth and Adult Education) and Problem-Based Learning with the subject of viruses.

As for the Choreographer's movements, in these expository classes, there was always mention of learning expectations, especially about learning how to learn so that teachers in initial training can teach in order to learn by thinking.

To this end, the trainer used texts, videos, films, and other materials to explain the content and encourage them to reflect on their different learning styles and how this diversity can affect the process of studying and, consequently, teaching Science.

When considering the activity of drawing up a Lesson Plan for a target audience for the work of a pedagogue, the basic model that came closest to what was carried out in the classroom by the undergraduates was the one that deals with Learning by Discovery, since actions were developed in the context determined for the activity, with the construction of meanings for appropriation through processes of searching for reality as future teachers of children, working in an authentic contextualization of a Science lesson (even if hypothetical); as well as providing moments to reflect on the experiences of the other groups in order to evaluate what might be more appropriate or not in school contexts.

Moreover, a final base model of learning, seen in the activities anticipated and put into play on the problem of Viruses, Bacteria, and Fungi as content for science classes, adheres to the Social Learning base model since the undergraduates' actions enabled research discussion, socialization, and reflection.

The rhythm of the dance proposed by the Choreographer reveals a significant influence on the definition of the metrics and repertoire of the dancers who, by dancing the great piece together, have established which melody and movements will form the basis of their professionalism as future multipurpose teachers. Furthermore, as a didactic model, the Model of Didactic Choreographies presents itself as an organic, humanizing, flexible, and creative formative possibility for training future multipurpose teachers to teach Science to children,



young people, and adults.

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