

Teachers of natural sciences: some challenges and perspectives in Brazil

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Abstract

The teaching of Natural Sciences has a fundamental role in contemporary education. However, the traditional emphasis on specific content unrelated to the context of the student has made it difficult to understand and act in an increasingly complex and interconnected world. It is fundamental and urgent to incorporate an interdisciplinary and integrated perspective in teacher education. This work brings to light the challenge of the integration of areas in the natural sciences from a contemporary perspective. In addition, it presents some elements results of the construction of a proposal for teacher education for Brazilian basic education.

Keywords: *Teaching of natural sciences; interdisciplinarity; teacher education.*

1. Introduction

The role and importance played by science and technology in the contemporary world is unquestionable. They are found in practically everything around us and have a strong influence on the way we think, act and live. To deny students basic knowledge such as: telecommunications, astronomical discoveries, energy, genome, transport systems, properties and transformations of materials, climate change, transgenics, among others, is to deprive this group of a sense of belonging to a society that is highly dependent on this knowledge.

However, science has for many years been traditionally taught by emphasising memorisation and the application of formulas that mean little to basic education students. A strong emphasis on long lists of specific content, without links to the student's context, often prevents the necessary depth of understanding and acting in a world that is complex, in which the variables are many and interconnected. The lack of meaning in the learning of these immense lists of contents, whose only goal is the achievement of tests and exams, has been alerted by different teachers, managers and researchers in the area of teaching of natural sciences.

It is essential to give the teaching of Natural Sciences a meaning more in line with the potential that this area has in human development throughout history. To this end, it is essential to incorporate a change of focus: the specific contents are important and essential, but they need to be at the service of something more comprehensive. The contents, therefore, should be seen as means and not as ends of the teaching of Natural Sciences.

Several researchers and educators have been warning for some time about a crisis of meaning in the teaching of natural sciences. If, in the past, the inclusion of scientific themes in basic education had as assumption the learning only of scientific contents distant from the students' reality, today this perspective does not make sense anymore, especially after the invention and dissemination of the internet in which specific knowledge is available at any time (FOUREZ, 2003).

2. Urgent action on Brazil

In Brazil, the debate has been urgent due to a major reform in basic education (BRASIL, 2017) and the implementation of a Common National Curricular Base (BRASIL, 2018) in which the knowledge of the natural sciences is guided by interdisciplinarity and the integration of areas. The primacy of interdisciplinarity and its correlates is already found in the original Parecer CNE-CEB 7, 2010, p.29: *“In the organization and management of the curriculum, the disciplinary, multidisciplinary, interdisciplinary and transdisciplinary approaches require the careful attention of the school institution, because they reveal the*

worldview that guides the pedagogical practices of educators and organize the student's work."

The area of knowledge Nature Sciences lists skills and competences to be developed throughout Basic Education in the thematic axes: Matter and Energy, Life and Evolution and Earth and Universe. Thus, contents that were previously seen in a fragmented way now need a more integrated look, so that the conceptual and methodological tools of the curricular components enable students to investigate, analyse and discuss problem situations that emerge from different socio-cultural contexts, as well as understand and interpret laws, theories and models, applying them to solve various problems of individual, social and environmental nature.

Faced with the challenge of teachers education for a world in deep transformation, the University of São Paulo, especially the Chair of Basic Education, linked to the Institute of Advanced Studies (CEB-IEA/USP) and in partnership with some university teachers, has led the debate and preparation of a project for an Interdisciplinary Science Degree, whose aim is, among others, "*[...] to educate teachers to work in basic school, implying a creative, systematic and responsible inter-transdisciplinary approach to school contents, providing a real transversality in their education*". (PPC, 2022, p.20). The participants are divided into students in the initial education process and teachers working in basic education, concomitantly and shared.

The idea of Inter-Transdisciplinarity can be understood in three different aspects: as an approach or methodology that facilitates the access to complex objects; as an action that overcomes or transits between distinct disciplinary fields; and as a education for or in teaching-learning processes between distinct disciplinary fields (PPC, 2022).

In order to structure the learning spaces, the degree is divided into 4 large education blocks: General Transdisciplinary Education; Transversal Pedagogical Education; Autonomous Project-based Education; Specific Interdisciplinary Education. The first three are common to other qualifications and not exclusive to the area of natural sciences, thus allowing for great integration in the education of teachers from different fields of school knowledge.

3. The sensitive case of natural science

The proposal for integrated teaching of Physics, Chemistry and Biology requires greater mastery of the three areas of knowledge by the teacher, as well as greater in-depth knowledge of astronomy and geosciences. This fact represents a major change in terms of science education in Brazil, leading to innovations also in the teachers' education for basic education.'

The curriculum integration proposed for the Nature Sciences in the BNCC seems to relate to the searches for function and meaning of school knowledge highlighted by Lenoir (2006) when analyzing the differences between visions of interdisciplinarity of different approaches and regions of the planet. The competences indicated in the document for nature sciences present concerns both in epistemological and social plans, as well as focus on the meaning of school knowledge, in the more practical and operational plan, by focusing its propositions in empirical social and environmental issues, and in processes and practices of scientific research, thus presenting concerns both in the function and in the meaning of school knowledge.

The integration of the areas of natural sciences faces a number of challenges ranging from methodological differences and language barriers to conflicts of interest, the resistance of teachers to work collaboratively, the lack of time and resources for integrated projects, the need for new forms of assessment and structural difficulties.

One of the main obstacles to the implementation of proposals that integrate knowledge and the development of interdisciplinary proposals in basic education is the initial teachers' education, usually based on a fragmented view of knowledge and the absence of interdisciplinary teaching materials (SILVA; MAGALHÃES, 2016).

Given so many obstacles involved both in the integration of the areas of natural sciences in basic education, as in the development of integrative proposals, the interest of this research focuses on the impact on the curricular organization of teacher education brought by the changes made in the area of Natural Sciences and their Technologies, by its unprecedented character, requiring a differentiated profile of the teacher of biology, physics, and chemistry, in accordance with an integrative and interdisciplinary discussion.

Undergraduate courses of interdisciplinary teacher education, although necessary, are still experienced in the early stages of construction and implementation in Brazil (GATTI et al, 2022). It is important to highlight that many of the existing degrees in Nature Sciences in the country, due to the tradition of fragmented disciplines, have difficulties in overcoming the content-based and disciplinary model. They end up reinforcing in their curricula the junction, the sum of physical, chemical and biological knowledge and not a real articulation among them.

One of the main criticisms that is made to the teaching of natural sciences is its compartmentalised, watertight and poorly articulated teaching. The lack of articulation in the undergraduate courses makes the challenge for natural sciences teachers almost insurmountable. Although the municipal and state education departments try to overcome the problem by offering some continuing education courses, the degree courses are still far from interdisciplinarity.

3.1. Building an undergraduate course focused on teacher education in an interdisciplinary perspective in Science

In an attempt to promote an expansion of the relations between the scientific knowledge mobilized, the proposal of the new Interdisciplinary Bachelor's Degree in Sciences (USP) carries out some movements: at the same time that it develops a panoramic vision of the scientific culture about our knowledge of the Universe, for example, it delves into its various phases and areas, with the objective of articulating the whole and the part. The introductory curricular component, to be taught by teachers with knowledge in different fields of knowledge (astronomy, physics, chemistry, biology, geoscience, education, philosophy and engineering) has the purpose of providing an overview of this knowledge that will be more and better deepened throughout the course. The idea is to investigate and debate on the knowledge of the Universe produced by the natural sciences over time and the main technologies and tools important to this construction.

Nature Sciences and your knowledge of the Universe

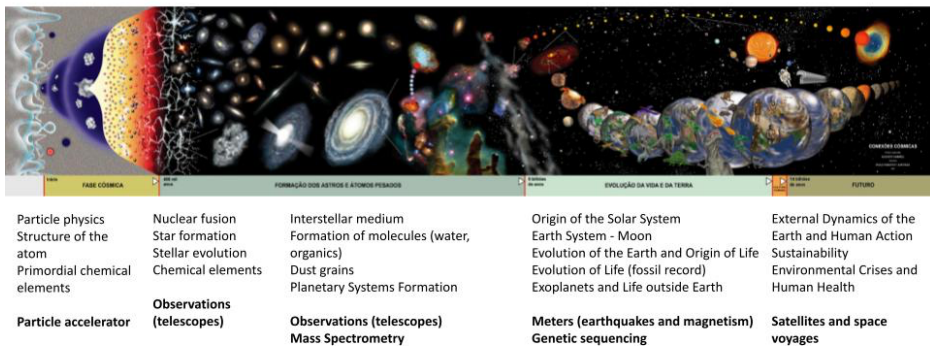


Figure 1. Science, Technology and the construction of knowledge.

The education in natural sciences aims to, while working on the fundamental concepts proposed by the BNCC (BRASIL, 2018): Matter, Energy; Life and Evolution; and Earth and Universe, structure and organize them from major themes that interconnect these topics, as well as by fundamental aspects and themes in science, such as: *Patterns and transformations in nature; Observations, modeling and simulations in the construction of knowledge in Natural Sciences; Energy and the challenges of the 21st century; Matter that forms us and surrounds us and its impacts on modern life; Life, health and environment; Light, radiations, their impacts and applications.*

Furthermore, the purpose of this course is to situate this knowledge in time and space, providing reflections and debates involving the nature of scientific knowledge, its

investigative processes and practices, its relationship with technology, with history and with culture and its relationship with educational spaces, especially the school.

In order to give life to innovative proposals in basic education, it is also part of the objectives of the new Interdisciplinary Bachelor's Degree in Sciences (USP) to structure supervised internships through the development of inter/transdisciplinary projects in partner public schools.

The proposal of the new Interdisciplinary Bachelor's Degree in Sciences (USP) dialogues with the concept of transversality introduced in the Brazilian educational regulatory framework (CNE/CEB, 2010, p. 24): "*transversality guides to the need to institute, in educational practice, an analogy between learning theoretically systematized knowledge (learning about reality) and real life issues (learning in reality and from reality).*" And has as reference the idea that to teach in an interdisciplinary way, the mere juxtaposition of content is insufficient. The necessary change consists of a change in the understanding and attitude of the future teacher (LENOIR, 2006; FAZENDA, 1995), and will only be possible with the overcoming, at least in part, of an exclusively disciplinary curriculum structure.

The work described here fits into the research model called Experiences Report (RE) and tries to seek to "*reach subjects, events and temporalities, the Report imbues other processes and knowledge, linked to modalities of scientific constructions more apt to recognize the importance of the use of narrative skills*" (DALTO and FARIA, 2019).

4. Some considerations

It is essential to highlight that we are immersed in a very dynamic world full of concrete challenges that urge us at all times. Living responsibly and actively requires a certain degree of scientific literacy and, therefore, the mastery of a series of competences and skills in which inter-transdisciplinarity is very present. Real-life problem situations are not, in general, specific to one component. From this perspective, the Natural Sciences proposed for the new Interdisciplinary Bachelor's Degree in Sciences (USP) intends to educate teachers who can meet the current educational demands, starting from real problem situations in which the knowledge of natural sciences is mobilized, in order to build a more just and equitable society.

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