

**Baseline STEM
education in Brazil:**
Reflections on
data analysis and
bibliographical
documents

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Baseline of STEM education in Brazil of STEM Education in Brazil:

Reflections on
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STEM Partnerships

Working Together


Diana Daste

Director of Cultural Engagement, Brazil and Acting Country Director of the British Council



The British Council is the United Kingdom's international organisation for cultural relations and educational opportunities. Founded in 1934 and established in Brazil since 1945, it works in the areas of Education, the English Language, the Arts and Culture. It encourages and supports the development of programmes that promote equality and quality. In the area of school education, it focuses on the teaching of the English Language and of Science and Technology, aiming to strengthen the skills of teachers and their performance in the classroom. We seek reflections and methodologies that are capable of improving the relationship between teaching and learning, and aim to increase the engagement of students in an inclusive education, as well as promoting partnerships between Brazil and the United Kingdom. In this way, we believe we contribute to human development and global citizenship.

The function and form of teaching the STEM subjects (Science, Technology, Engineering and Mathematics) has been changing throughout the world. The United Kingdom is respected



worldwide for its work in the area, evaluating and documenting experiences, methodologies, policies and their application. This publication is part of the British Council's global STEM Education programme, which aims to encourage wide access to science and technology education, from the perspective of an integrated, evidence-based education.

The overall objective of the programme is to build connections between the United Kingdom and Brazil in the STEM area. The investigations and training activities are focused on citizen science, critical pedagogies, informal education spaces and inclusion (especially black girls), aiming to identify and promote methodologies which can be replicated in schools in the two countries. Computational thinking is a key skill, required to meet the challenges of engagement, resources, infrastructure and training, while in-service training (INSET) is a transformative element in education systems.

How to manage and encourage transformative processes in the STEM area? What are the strategic choices and elements needed to advance on the path towards a quality teaching and learning environment? What projects will make a difference?

It is by reflecting on these questions that we interpret the content of this publication, in order to propose high-impact interventions founded on the transformative ability of the sciences, with the teacher at the heart of the actions.

The challenge requires various sectors to engage. We invite the reader to exchange experiences and work together towards transforming education.

Data, various conversations and reflections

Alessandra Moura

Head of English and Schools Programmes



The fruit of a two-year research project carried out by researchers at the Carlos Chagas Foundation, the analyses and reflections to be found in this new study are intended to contribute to the formulation of digital and natural science education policies in Brazil.

Data on the attractiveness of the teaching career, the profile of educators, as well as insights into the fundamental importance of INSET for improving the quality of education are especially relevant to the design of evidence-based public policies. To a large extent, the research consolidates information about the current situation of Brazilian STEM teaching and learning, with its foundation in a close look at Brazil's educators. This makes sense, because if the student is the central figure in the school, it is the educators who are the movers and shakers in schools. While technology and artificial intelligence advance in leaps and bounds, it is still impossible to imagine schools without teachers.

Furthermore, it is clear that there must be an increased emphasis on promoting equality STEM education, especially amongst girls. They need to hear words and experience actions that encourage them to pursue STEM careers – careers that can make a major contribution to sustainable development. It is essential to combat the invisible bias that still encourages them to think that they would not be good scientists, mathematicians, engineers or programmers.

Before inviting readers to dive into this publication, it is important to point out that nothing is more valuable in the work of the British Council than the trust and collaboration we have established with the countless specialists we work with in the countries where we operate. Without them, no contribution or outcome would be possible. This is why research such as this results not only from data analysis, but from many people exchanging their experiences, knowledge and reflections. We seek to list and thank them all on the introductory pages of this publication.

As you look at the look list of names, you will be able to imagine the long and fascinating conversations we have had in reaching these results. For the British Council and our team in Brazil, it was an honour and a pleasure. We hope that this STEM Panorama will be a starting point for new partnerships and other projects that strengthen STEM in Brazil.

The origins of Baseline research of STEM Education in Brazil:

The teaching of science and technology in the Brazilian school system - analysis 2010 to 2020

Established in 1964, the Carlos Chagas Foundation (FCC), stands out in Brazil for its excellence in the fields of educational research, selective processes and systems analysis. As a protagonist in Brazilian education, through its Department of Educational Research, the FCC has been dedicated since its inception to research programmes on topics directly or indirectly related to evaluation, public policies, teacher training and work, social rights, age relations, gender and racial relations. Over the years, the Foundation has broadened the range of topics it is concerned with and the approaches adopted, which are currently structured around five research groups: Educational Assessment; Education and Childhood: Policies and Practices; Gender, Race and Ethnicity: Education, Work and Human Rights; Policies and Practices of Education and Teacher Training; and Social Representations, Subjectivity and Education. These groups are registered in the Directory of Research Groups of the National Council for Scientific and Technological Development (CNPq) and, in addition to working towards institutional requirements, undertake projects in collaboration with Brazilian and in-

ternational teaching and research entities, government agencies and civil society institutions, resulting in a multidisciplinary contribution to educational issues.

In 2020, the British Council proposed a partnership with the Carlos Chagas Foundation's Gender, Race, Ethnicity: Education, Work and Human Rights Research Group. This proposal was the result of a mutual interest in projects and actions that aimed to reflect in more depth on educational inequality, aiming to improve equality in academic and professional career paths. Within this overall ambition, the particular interest of both institutions in STEM education stands out, especially encouraging the interest and participation of girls in science and professions which few of them enter. It is generally understood that challenging inequality in education needs to start in the early years of schooling. From primary education on, biology, physics, chemistry and other content are included in the curriculum, while the mathematics curriculum includes algebra, calculus, geometry and other areas. Recognising that there was no panoramic overview available of the area, the project *The Teaching of Natural*

Sciences and Technology in the Brazilian School System - a Panorama of 2010 to 2020 emerged.

The project aims to help education professionals and researchers participate in conversations on educational policies and propositions for teaching science in schools, especially in the final years of middle school. To provide a comprehensive view of science education in Brazilian schools, highlighting specific issues and challenges, the researchers at the Carlos Chagas Foundation examined three key dimensions of the topic: the legal frameworks, research published on the SciELO platform, and the Brazilian School Education Census (CEB) and Higher Education Census (CES) databases. The aim of the research is to inventory and describe aspects which are key to an understanding of the teaching of the natural sciences and their related technologies in schools, with an emphasis on teacher training, methodologies and teaching practices. To this end, elements have been gathered together that allow us to identify concepts and characteristics that contribute to a dialogue on the complexities of teaching the natural sciences, as has been considered and proposed by current educational policies, in particular with the implementation of the Brazilian Common Core Curriculum (BNCC).

The work was divided into six stages:

- 1** Temporal and spatial delimitation of the object of the study;
- 2** Definition of the sources of information to be used for each of the dimensions defined, including legal frameworks, academic research and other documents and statistical data;
- 3** Organization of data and information collected on the basis of the three predefined dimensions;
- 4** Drafting of the chapters corresponding to the three dimensions defined;
- 5** Technical workshop with peers in the field of science to consider the draft report; critical reading by the British Council;
- 6** Production of the final document, with recommendations.

This process resulted in the study, the full content of which can be accessed at:



This booklet highlights some of the topics covered by the research and illustrates them with the perspectives and perceptions of experts, teachers and educational managers, the challenges facing education professionals, especially school leaders, and means of inspiring them into action.

Enjoy your reading!



A Brief X-Ray of the Numbers

ACADEMIC LITERATURE

When. March 2021

Where. SciElo Platform

Main Descriptor. "Teaching of Science"

Time period. 2010 to 2020

First selection. 281 articles published

THE JOURNALS WITH MOST ARTICLES

CIÊNCIA & EDUCAÇÃO

(UNESP, BAURU, POSTGRADUATE PROGRAM
IN EDUCATION FOR SCIENCE, FACULTY OF SCIENCE)

153

ENSAIO, PESQUISA EM EDUCAÇÃO EM CIÊNCIAS

(FEDERAL UNIVERSITY OF MINAS GERAIS,
FACULTY OF EDUCATIONS, BELO HORIZONTE)

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BRAZILIAN HIGHER EDUCATION* AND SELECTED TEACHING DEGREES**

TOTAL NUMBER OF STUDENTS ENROLLED IN BRAZIL

8.603.824

IN-PERSON

6.153.560 (71,5%)

E-LEARNING

2.450.264 (28,5%)

2019

SELECTED TEACHING DEGREES

265.152

FACE-TO-FACE

181.357 (68,4%)

E-LEARNING

83.795 (31,6%)

2019

*Data from the Higher Education Census, INEP/MEC

**Selected in-person and distance learning teaching degrees in public and private institutions: science, biology, physics, chemistry, mathematics, and computing.

The Time for Science and Technology

It is challenging to arrive at an accurate overview of the teaching of STEM-related disciplines, which are important for young people to understand the great themes that affect humanity in both the present and the future, such as climate change, artificial intelligence, the concept of innovation, among so many others, while helping them towards a promising professional future.

According to the National Institute of Education Studies and Research (INEP), there are 2.7 million teachers in all subjects in primary and secondary schools in Brazil¹. Under the Brazilian education system, primary school teachers are trained in pedagogy in order to teach at that level. Middle school and secondary school teachers, on the other hand, should hold a teaching degree or a PGCE in the the subject they teach. Teachers may actually teach a variety of subjects and be active in different classes and schools, exercising what is called a *teaching function*. If this characteristic of Brazilian education is taken as a measure, we find that 3.7 million teaching functions are involved in teaching the STEM subjects of Biology, Physics, Chemistry, Mathematics and General Science. For a consistent analysis, it is essential to consider the specificity of teacher education for each stage, class and subject.

1. Source: Summary of the School Education Census, 2020, INEP

This Baseline research examines the data on middle and secondary school education found in the School Education Census (CEB/INEP), aiming to contribute to an analysis of teacher training and qualifications for STEM-related subjects. For the purposes of the research, the unit of interest is the teaching function, not the individual teacher per se. For numerical purposes, each teaching function corresponds, therefore, to the teacher/class/subject combination. In this booklet we highlight some aspects of the data in order to contribute discussions on the quality of the teaching offered, as well as to provoke a closer examination of INSET courses on science and related subjects.

Rather than being satisfied with the sheer quantity, size and complexity of science teaching in Brazil, it is necessary to improve the quality of teaching and learning across all subject areas, including STEM. A major step forward in this process is to ensure that there are more teachers who are trained in the subjects they teach. Facing the teacher in the classroom, there were almost 34.5 million children and young people enrolled in primary and secondary education in 2022, according to INEP's School Census. They are the potential beneficiaries of a high-quality STEM education, either directly from the teaching itself or indirectly through the discovery of new solu-

tions for human coexistence and valuing of biodiversity. Of that total, 11.8 million pupils are in middle schools (69.3% in municipal schools, 11.7% in state schools), while 7.86 million are studying in secondary schools - 84.2% of them in state schools. (CEB/INEP, 2022)

There is still a long path ahead to reach the desired level of scientific literacy. The challenge facing the sciences can be seen in the results of the Brazil School Education Assessment (SAEB) of 2019, where more than 50% of the nation's middle school pupils achieved scores at the lowest proficiency levels. The exam, taken by a sample of pupils, showed that 51.71% of them were only at stage 2 out of the 9-stage scale.

Encouraging the inclusion of science in the SAEB assessment may contribute greatly to the definition of actions and policies aimed at achieving effective teaching of the subject. The snapshot of the topic in this booklet is not intended to look in detail at all the teachers who teach STEM subjects in Brazil, but to throw a light on some of the key issues facing the area. These include the infrastructure available to teach STEM and an overview of initial and in-service teacher training, as well as discussions with teachers, researchers and leaders in the education sector, who are required to deal every day with the different challenges facing Brazilian education.

We hope that this booklet will be read by leaders of the various levels of the public education system and inspire them to reflect on actions and programs aimed at the teaching of STEM subjects, thereby strengthening moves to an interdisciplinary approach to school education, so that we can achieve the education and learning indicators required at all levels.

**STEM areas:
Science
Technology
Engineering
Mathematics**

The BNCC, the BNC and INSET: the potential for transforming practices and visions


Documents change how science should be taught

In 1996, Brazilian school education went through a series of legal transformations that changed the conceptual foundation for the education of young people, starting with the passing of the Law of Educational Guidelines and Frameworks. Among the new legal frameworks, the main ones which have been introduced since 2017 are the BNCC for pre-school, primary and secondary education, and the BNC for teacher training courses. To a greater or lesser extent, depending on the educational stage, these documents have changed how science should be taught in Brazil.

For Eduardo Deschamps, former Secretary of Education for the State of Santa Catarina, a former member of the National Council of Education and former President of CONSED (National Council of State Secretaries of Education), the changes will have a stronger impact on secondary education than on primary education, but it will certainly change the perspectives of the latter.

“When we talk about the curriculum, particularly the National Curriculum, it identifies the essential learnings that pupils should achieve, irrespective of the subject. In essence, we stop focusing on content and concern ourselves more with competencies and skills. This means a change in the attitude of the teacher, who should become more concerned with problem solving than with delivering content. This has an impact across the board”, he says.

The right to learn, competencies and skills are the central issues, but they must be related to the objects of knowledge – the concepts and contents – as the research points out in its analysis of the new frameworks. In the case of the natural sciences, the curriculum is divided into three areas, all of which are covered over a number of years, at ever greater depth. They are: The Earth and the Universe; Life and Evolution; Matter and Energy. This gradual approach aims to help students experience processes as they improve their scientific literacy.



These thematic divisions do not imply a change to the curriculum, because there has been no change in the BNCC for primary education, unlike in secondary education, where schools are encouraged to organize their learning approach across subject areas, through multidisciplinary projects. However, says Deschamps, if the structure of the curriculum of the final years of primary education is not changing, there are new ways of working with it. **“Pedagogical practices change, encouraging the use of active methodologies and technology, but mainly encouraging the development of competencies and skills.”**

In the case of teacher training for secondary school science teachers, one of the central focuses is the way teachers act within the school.

Science, technology and society

One aspect that continues to generate controversy is the general population’s view of the sciences, especially following the pandemic. The Panorama includes the views of teachers Estevao Antunes Jr., Cláudio Cavalcanti and Fernanda Ostermann criticising the National Curriculum for, in their words, being aligned with those voices that strengthen the concept of “scientific neutrality” and the myth that scientific development always brings only benefits. From a more contemporary point of view, especially in times of climate change,

“We are talking about training that helps them to work together and articulate their knowledge. We need teachers with a good foundation in their subject matter, but who can articulate this knowledge with the other subject areas and work with other teachers.” For those with teaching degrees in general science rather than the individual sciences, their training is already multidisciplinary, but the intention behind the INSET National Curriculum is to open the way to expand this training. “We have passed resolutions that enable the teacher to have more than one teaching degree. The idea is not to do this in a superficial way, but to allow the teacher to deepen relations between the different subject areas,” he concludes.

it is essential that school education provides citizens with the tools they need to help them form an opinion on the consequences of human actions on the environment and even interventions involving the human body. “We should be able to deal with and discuss the consequences of the pandemic while teaching science, technology and society. Especially because at some point a significant part of society began to doubt science,” says Deschamps, referring to negationism.

//An X-Ray of Teaching Degrees//

The growing presence of federal universities

In-person teacher training courses for the teaching of the natural sciences and technologies are more common in public higher education institutions (IES). In private institutions, the number of courses offered through distance learning, or education at a distance (EAD), has expanded significantly.

Two data items stand out when analysing data on Brazilian higher education, in particular those relating to the teaching degree courses selected for the research STEM survey carried out by the Carlos Chagas Foundation, with the support of the British Council. They concern the increase in EAD courses on offer in the sector, and the increasing importance of Federal universities in offering degrees in this field.

During the period 2010 to 2019, the number of enrolments in Brazilian higher education as a whole (public and private) grew from 6.3 million to 8.6 million, an increase of 34.8%. This increase was, however, significantly greater for EAD courses than the traditional in-person courses. While enrolment in EAD courses jumped from 930,000 in 2010 to 2.45 million in 2019, a 163% growth, enrolment in in-person courses only rose by 12.9% over the same period (from 5.44 million to 6.15 million).

BRAZILIAN HIGHER EDUCATION* AND SELECTED TEACHING DEGREES

TOTAL ENROLMENTS BRAZIL	8.603.824
TOTAL IN-PERSON BRAZIL	6.153.560 (71,5%)
TOTAL EAD BRAZIL	2.450.264 (28,5%)
TOTAL SELECTED TEACHING DEGREES**	265.152
TOTAL SELECTED TEACHING DEGREES IN-PERSON	181.357 (68,4%)
TOTAL SELECTED TEACHING DEGREES EAD	83.795 (31,6%)

* DATA FROM THE HIGHER EDUCATION CENSUS, INEP/MEC

** SELECTED TEACHING DEGREES: IN-PERSON AND EAD SCIENCE, BIOLOGY, PHYSICS, CHEMISTRY, MATHEMATICS, COMPUTING, PUBLIC AND PRIVATE UNIVERSITIES.

*** CORRESPONDS TO PANORAMA TABLE 1 (SCHOOL CENSUS 2019).



Among the teaching degrees selected for the study, mathematics (46.5%) and computing (46%). EAD courses experienced the highest growth. The authors of the research hypothesize that the incentive to open new courses in mathematics, besides being necessary due to the importance of the subject and the high demand for mathematics teachers, is that it was easier for the institution to establish courses in these subject areas, given the relatively simple infrastructure required. This growth was not seen in subject areas that normally require investment in physics, chemistry and biology laboratories.

To analyse the implications of EAD, the Baseline research refers to a previous study, published by UNESCO (2009), which analyses the caution that educators tend to have in relation to this delivery modality. The study lists a series of requirements which must be met to be able offer a high-quality course, such as well-prepared lecturers in the area with a good knowledge of what is needed, such as “sophisticated and agile technologies; well-produced and tested materials”, among other attributes. The researchers emphasise that the caveats do not apply to the modality itself, but the way it is offered, where courses frequently do not meet the basic requirements.

For Amadeu Moura Bego, a lecturer on the chemistry teaching degree course at the Chemistry Institute, Araraquara Campus, UNESP and an advisor to the Dean of Undergraduate Studies, the EAD courses ensure greater heter-

TEACHING DEGREES: IN-PERSON X EAD

IN-PERSON ENROLMENT RATES

GENERAL SCIENCE	95,2%
CHEMISTRY	81,7%
PHYSICS	80,2%
BIOLOGY	73,9%
COMPUTING	54%
MATHEMATICS	53,5%

EAD ENROLMENT RATES

MATHEMATICS	46,5%
COMPUTING	46%
BIOLOGY	26,1%
PHYSICS	19,8%
CHEMISTRY	18,3%
GENERAL	4,8%

* THESE DATA REFER TO TABLE 2

ogeneity, in the same way as in-person courses. However, a requirement that complicates this delivery mode is the supervised school placements, which by their nature must be in-person, but which frequently result in pro-forma placements which do not give the future teacher the necessary experience of classroom practice.

“At times, the teacher trainee is not actually present in the classroom, is not observing an experienced teacher or concerned with their training”, says Amadeu Bego, who is responsible for oversight of teaching degrees for the Dean of Undergraduate Studies. He mentions the positive example of the Virtual University of the State of São Paulo (UNIVESP), which has set up a school

placement department which is responsible for establishing partnerships between schools and universities, so that the student can have real classroom-based experience.

He also identifies another problem with EAD courses, which is that frequently they are the first experience of young people in higher education, which is not recommended, mainly for those coming from an underprivileged social and cultural situation who have had little experience of reading or science museums, as well as other cultural experiences. The EAD courses require a set of skills and competencies that the student who is studying at a university for the first time does not necessarily have. These include organising their time and the ability to read and study on their own.

“When such students are studying on an in-person course, their social interactions can overcome the absence of some skills. In the lecture theatre or seminar room, the lecturer interacts with the students more closely, while they undertake group projects and seek the help of their colleagues, creating a supportive social environment which reinforces the process of teaching and learning”, says Bego.

In the state institutions, enrolments in face-to-face courses in computing declined by -40%, while general science enrolments declined by -48.3%, while the latter subject experienced an even more significant reduction of -67.5% in EAD course enrolments. On the other hand,

PERCENTUAL VARIATIONS BETWEEN IN-PERSON AND EAS COURSE ENROLMENTS FOR SELECTED TEACHING DEGREES – 2010 AND 2015

IN-PERSON ENROLMENTS

TOTAL	21,7%
COMPUTING	11,4%
BIOLOGY	- 13,7%
GENERAL SCIENCE	- 9,7%
PHYSICS	9,1%
MATHEMATICS	-8,9%
CHEMISTRY	6,5%

EAD ENROLMENTS

TOTAL	49,8%
COMPUTING	69,1%
BIOLOGY	-15,2%
GENERAL SCIENCE	-39,4%
PHYSICS	-48,5%
MATHEMATICS	22,5%
CHEMISTRY	-6,5%

TOTAL VARIATION (IN-PERSON + EAD)

OVERALL TOTAL SELECTED TEACHING DEGREES	25,8%
COMPUTING	30,2%
BIOLOGY	-14%
GENERAL SCIENCE	-12,7%
PHYSICS	-4,2%
MATHEMATICS	0,0%* (ROUNDED NUMBER - 0.06%, 55 STUDENTS)
CHEMISTRY	4,8%

* THE VALUE OF 0.0% IS THE ROUNDED NUMBER 0.06% (55 STUDENTS), DUE TO THE PRECISION FACTOR USED IN THE TABLES.

** CORRESPONDS TO TABLE 3.A.

VARIATIONS OF SELECTED TEACHING DEGREES BY ADMINISTRATIVE CATEGORY

FEDERAL NETWORK		STATE NETWORKS		PRIVATE SECTOR	
COMPUTING	104,8%	COMPUTING	-14,5%	COMPUTING	-21,9%
BIOLOGY	17,8%	BIOLOGY	6,7%	BIOLOGY	-38,7%
GENERAL SCIENCE	40,7%	GENERAL SCIENCE	-36,4%	GENERAL SCIENCE	-83,1%
PHYSICS	-2,6%	PHYSICS	-10,6%	PHYSICS	-0,3%
MATHEMATICS	2,8%	MATHEMATICS	-17,4%	MATHEMATICS	11,1%
CHEMISTRY	24,1%	CHEMISTRY	5,1%	CHEMISTRY	-33,5%

* EXTRACTED FROM TABLE 3B BASELINE RESEARCH

CHANGE IN THE PERCENTAGE OF FACE-TO-FACE ENROLMENTS/EAD, BY SELECTED TEACHING DEGREES – 2015 TO 2019

IN-PERSON ENROLMENTS		EAD ENROLMENTS		TOTAL	
COMPUTING	-6,6%	COMPUTING	7,6%	COMPUTING	-0,6%
BIOLOGY	-12,7%	BIOLOGY	27,8%	BIOLOGY	-4,8%
GENERAL SCIENCE	-6,8%	GENERAL SCIENCE	-36,8%	GENERAL SCIENCE	-8,9%
PHYSICS	13,7%	PHYSICS	97,7%	PHYSICS	24,1%
MATHEMATICS	-5,4%	MATHEMATICS	55,9%	MATHEMATICS	15,7%
CHEMISTRY	1,0%	CHEMISTRY	75,2%	CHEMISTRY	9,5%

* *THIS DATA CORRESPONDS TO TABLE 4A

** The period from 2015 to 2019 coincides with a worsening of the economic, social and political crisis faced by Brazil. This context is reflected in the rate of growth of higher education, four times lower than that seen between 2010 and 2015, with a decline in the offer of in-person courses of -7.2% and a significant growth in enrolment in EAD courses of 75.8% (Table 4a). However, the decline in enrolment in general science courses of -36.8% demonstrates that no EAD courses in the subject were offered, while the number of enrolments in in-person courses also suffered a decline of -6.8%. It should be emphasised that general science is an introduction to science for pre-school and primary school students.

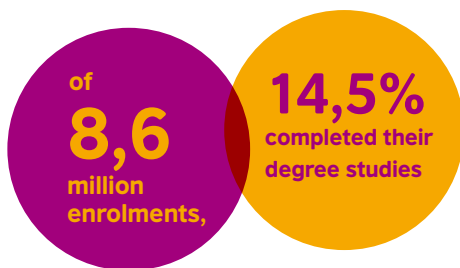
EAD physics (132.5%) and mathematics (143%) experienced higher enrolments (Table 4b of the Panorama).

In the private sector, the highest percentage growth in EAD natural science enrolments was in the subjects of physics (163.9%) and chemistry (195.3%).

In the face-to-face modality, there was a percentage decline for all selected teaching degree courses in computing between 2015 and 2019 which was higher in private sector institutions (-83.4%), while EAD courses in the same area showed a reduction of -15.3%.

Drop in in-person teaching degree enrolments

The total number of enrolments in in-person courses declined by 480,000 between 2015 and 2019. In the case of the selected teaching degree courses, a significant proportion of this total was in state and private universities and faculties. In both cases, the courses which experienced the greatest decline in enrolments were computing and general science. The decline in enrolments in these two subjects also means that in 2019 they are the teaching degrees with the lowest absolute number of enrolments amongst the six subjects which are the subject of this study. In the case of the in-person modality, the private universities registered a decline across all the selected group of courses (computing, biology, chemistry, physics, general science and mathematics).



The most likely hypothesis in this case is that the economic crisis resulted in a reduced number of new students, because there were restrictions on student financing and, potentially, a greater need to seek work. It may also be the case that the offer of places in state universities has reduced, due to restrictions to their budgets.

VARIATIONS OF SELECTED TEACHING DEGREES BY ADMINISTRATIVE CATEGORY

FEDERAL INSTITUTIONS

COMPUTING	104,8%
BIOLOGY	17,8%
SCIENCE	40,7%
PHYSICS	-2,6%
MATHEMATICS	2,8%
CHEMISTRY	24,1%

STATE INSTITUTIONS

COMPUTING	-14,5%
BIOLOGY	6,7%
SCIENCE	-36,4%
PHYSICS	-10,6%
MATHEMATICS	-17,4%
CHEMISTRY	5,1%

PRIVATE INSTITUTIONS

COMPUTING	-21,9%
BIOLOGY	-38,7%
SCIENCE	-83,1%
PHYSICS	-0,3%
MATHEMATICS	11,1%
CHEMISTRY	-33,5%

* EXTRACTED FROM TABLE 3B

Enrolments vs Graduates

A worrying aspect, both in relation to the overall offer of courses and in the case of teaching degrees in particular, is the ratio between the total number of those who enrol and those who actually graduate. In 2019, of the 8.6 million students enrolled, only 1.25 million graduated, which is just 14.5% of the total.

For the selected teaching degree courses, the ratio between enrolments and graduating students was even lower, at 11.5%. The highest ratio was 14.4% for biology, followed by mathematics at 11.1%. The worst ratios were for physics, at 8.1% and computing, at 7.2%. In the case of computing degrees, as there is a

lot of demand in the IT market for professionals in the sector, there are frequent reports from university lecturers that many students leave the course before graduating, after obtaining jobs in the sector that offer better salaries than those offered by the teaching profession.

RATIO OF ENROLMENTS AND GRADUATES, BRAZIL AND SELECTED TEACHING DEGREES, 2019			
	ENROLMENT	GRADUATES	RATIO - %
TOTAL ENROLMENTS BRAZIL	8.603.824	1.250.076	14,5
TOTAL SELECTED TEACHING DEGREES	265.152	30.437	11,5
GENERAL SCIENCE	10.430	1.151	11
BIOLOGY	79.309	11.426	14,4
PHYSICS	30.175	2.459	8,1
CHEMISTRY	38.517	3.945	10,2
MATHEMATICS	95.789	10.670	11,1
COMPUTER SCIENCE	10.932	786	7,2

* CORRESPONDS TO TABLE 6

Inspiring ideas for good initial teacher training

Many teaching degrees have been renewing their approach, trying to modernise themselves, not only to account for the challenges of teacher training, but also to ensure that students complete the course. As both Amadeu Bego and André Luiz Oliveira, Associate Coordinator of the Integrated Chemistry and Physics Teaching Course at the Faculty of Education of the State University of Campinas (Unicamp), have explained, in many cases the students entering the courses have difficulty because of deficiencies in their school education.

“We aim to support subjects such as mathematics and physics for those who come with gaps in their secondary education”, says Oliveira. Bego adds that, in comparison with B.Sc. courses in areas such as medicine or biology, teaching degree students need more support. “The competitive entry conditions for publicly funded institutions means that most students studying for these other careers arrive with a much better education level,” he says, because this is the condition for entry into those courses.

He emphasises the need for the course to combine theory and practice from the start, ensuring

that students have significant experiences during their training placements, so that they can match what they see in the classroom with what they themselves learned.

Otherwise, the UNESP lecturer stresses, they will arrive in a “highly complex and unique environment”, as some scholars characterise the classroom, without having the tools they need to deal with the variety of situations and people they will face.

“What works in class A does not work well in D. There is no infallible technique that serves all students and contexts. The teacher needs to develop an ability to both deliver a lesson and to recognise what is inherent in the activity. Bego gives the example of a distant analogy: “I can study everything about cycling, but if I never ride my bike I will not learn”.

The integrated course at Unicamp was designed to overcome these and other problems.

During the course, the students study both chemistry and physics, in addition to other subjects in the fields of education and the humanities. At the end of their third year, the student chooses one of the two subjects to graduate. “This course was born from this perspective, being built on accounts of previous experiences. And now it will also make it possible to qualify in the natural sciences, as frequently these teacher graduates start working in a school and see that they are capable of teaching general science”, explains Oliveira.

It is more common for those who enrol directly in a teaching degree course to abandon it formally or stop studying. Those who enter the course after studying for a B.Sc. see that the job opportunities in the teaching profession are much greater, so are less likely to abandon the course. For many people, teaching represents a tremendous opportunity to advance socially and economically.

Research and Analysis

The importance of science in everyday life requires that education helps students understand the processes of knowledge production and to experience them in their daily lives.

Scientific knowledge has been changing at an accelerating pace since at least the middle of the last century. Largely because of this flow of new knowledge and the perception of its impact on society in general, the way in which science is taught has also changed.

It is more than that – it needs to change.

As a result, the methodologies and practices used to teach the natural sciences such as physics, chemistry and biology have been changing in recent decades. As it changed from an emphasis on procedures, much in vogue in the post-war period, to an approach more concerned with concepts in the early 1970s, science teaching has become more focused on critical analysis as it seeks to help the student develop a rational thought process that helps them understand the role of science in society.

In terms of the methodology, according to Lucia Sasseron, Associate Professor at the Department of Teaching Methodology of the Faculty of Education of the University of São Paulo (USP), this translates into the use of a tripartite scientific reasoning model. This model involves the development of research, argumentation and modelling competencies for the problems studied.

For Sasseron, it is not just about encouraging teachers – both the more experienced and the new ones – to use these procedures. “Many students who start studying for a teaching degree report that they had very few lessons while at school in which they learned to investigate or argue.” In other words, teachers themselves need to get used to this new model, which requires more reflection and participation from the students.

She points out that the classroom nowadays is quite different from what it was before. She also warns: “Some 20 years ago, the school was still one of the main sources of information for students, even if they had a television at home. Today, an enormous of information comes from the social media. Smartphones and computers have roles similar to the textbook. However, they are also frequently the source of negationist ideas and fake news.”

For this reason, school science education is essential to help young people develop and use an analytical ability, so that they treat misguided or hasty conclusions with a certain distrust. Sasseron cites the case of the drug chloroquine in the pandemic, when its supposed efficacy was trumpeted on the basis of a single article about a trial involving a small group of patients which had not been the subject of more rigorous checking. Knowing how to handle this information is vital. “Pupils need to learn about the internal mechanisms of science in the classroom”, she emphasises.

For Sasseron, it would be ideal if all public schools had laboratories and technicians, a situation far from the reality they face. However, if the laboratory is recognized as a space for doing science, not all science is done there. From this perspective, she gives two simple examples of experiments that can be carried out by students who do not have access to a laboratory.

The first requires the creation of a vegetable garden, where many observations can be made. One project uses a question that generates a lot of curiosity as the starting point: is it true that caterpillars become butterflies? To investigate this proposition, students must first establish a set of procedures that allow the same caterpillars to be tracked over a number of days. “To do this, the teacher asks questions that help students plan how they will be able to observe the garden and the insects until they register the transformation.”

Another example, this time from thermodynamics, is observing the behaviour of water when it is heated. In this case, it is necessary to use a glass container, such as a beaker, to hold the water as it is heated, and some thermometers. Sasseron explains that the students first record the temperature in a table as it rises and then represent the data in a graph that shows the moment when the temperature stabilizes. But this curve can be different if the water is heated in different ways, changing the time it takes to reach the stable point in the graph.

Other examples involve observing meteorological phenomena, such as hurricanes and lightening. “None of these needs access to a laboratory, just the analysis of data available”, she concludes.

Haira Gandolfi

From Brazil to the United Kingdom: Experiencing Teacher Education

Haira Gandolfi graduated with both a teaching degree and a B.Sc. in Chemistry from the University of Campinas (Unicamp), a public university funded by the State of São Paulo. She says that the course was general in nature, offering the students the opportunity to study for a B.Sc. in Industrial Chemistry, a B.Sc. in Chemical Science or a Teaching Degree in Chemistry as their studies progressed. Before entering Unicamp, she studied at a technical high school administered by the university. The Chemistry course enabled her to graduate with two degrees - a B.Sc. in Chemistry Teaching and a B.Sc. in Industrial Chemistry. While at university, she had the chance to experience various internships and an introductory course to scientific research. From her second year, she worked as a student coach in private colleges preparing students for public university entrance exams and had various internships in high schools. "I always liked school. When I finished my studies at Unicamp, I decided to become a teacher. This decision was very much based on my experience on the teacher training course and the internships." In this interview, she speaks of how Brazil and the United Kingdom have different approaches

to training science teachers, which should be shared so that both countries can improve the teaching of science.

England¹

"In 2015, I went to England to study for a doctorate in the history and sociology of science applied to education at the London Institute of Education, now part of University College, London. My doctoral thesis involved publicly funded schools in England. I had direct contact with teachers and now work in teacher training for the educational authorities. I have been a Lecturer at the Faculty of Education of the University of Cambridge since 2020, working on a number of aspects of teacher training at all levels, from undergraduate courses and PGCEs to masters and doctoral programmes. I work in teacher training across all the subject areas, not just the sciences. I coordinate the General Education Theory programme for the faculty, which is equivalent to the Brazilian Fundamentals of Education (Psychology, Sociology, History, Philosophy of Education) course that all students have to study. I work with students from all subjects, not just science students."

1. The countries which comprise the United Kingdom, notably Scotland, have school systems which differ from each other. This article reflects Haira Gandolfi's experiences in the English school system.

Sharing the Brazilian Experience

“One of the reasons why I was asked to coordinate the General Education Theory course is that our courses in Brazil in this area are much stronger than here in the UK. I bring a lot of the topics from the Brazil course to the faculty, from theories of education and Paulo Freire to issues that we work on in Brazil. I insist on the inclusion of theoretical discussions of topics such as critical pedagogies, anti-racist education, education for social justice. None of these topics are part of the official UK teaching degree curriculum, they are not mandatory content. But I, as Coordinator, strive to include them in the course – this is something I brought from my own studies.”

“I have brought content from Brazil which is very important for teaching practice and is linked to the theories of science and society, which helps us to position ourselves as science teachers. All these things seen through our Brazilian lens, such as the environment, for example, are not currently part of the official science curriculum here.”²

2. The Department for Education in England has recently launched its Sustainability and Climate Change Strategy, which includes a new Natural History GCSE course. The course will be introduced in September 2025.

Mentoring

“I learn a lot from the schools with which I work as a mentor, which is something that was lacking in my own training. Here they handle the transition from a graduating to becoming a teacher better, and they also work very well with families, the relationship between school and community – in Brazil we are less prepared to deal with families, with the problems of the families of our students. I learned this very much through practical experience, through being thrown into the classroom and having to deal with family problems brought by the students – serious problems. I never received help which prepared me for this during my teaching course. In England, we prepare our students better at university, including the more bureaucratic side of things – what should I do if such-and-such happens, what is the procedure, what is the legislation, how do I operate as a teacher in the classroom.”

“Here, they prepare their students much better to deal with extra-classroom issues, which are often complex and involve psychological or mental health issues. They are also concerned with the inclusion of students with special needs.”

Stimulating a Critical View

The terms science literacy and scientific literacy, sometimes used as equivalents, represent different notions of knowledge and learning.

Scientific literacy or science literacy? Doubts and possible confusion or divergences about the use of these two expressions precede their articulation. They are derived from the differences between knowledge and literacy, regarding the acquisition of reading and writing skills and the use of these skills after they are acquired.

According to the linguist Magda Soares, “science literacy gained the status of a technical term in the lexicon of the fields of education and language sciences” as early as 1988, when Leda Tfouni distinguishes the two terms in her book *Adultos não alfabetizados: o avesso do avesso* [Illiterate Adults: The Reverse of the Reverse] (Editora Pontes). The great difference, both in the field of language and science, is in terms of the **ability** to use the knowledge acquired (dominating the code in the case of language, and terms and

concepts in the case of science). Vanessa Santos and Amilton Cesar Santos (2018), summarizing theories, explain science literacy as what is related [...] to the ability to understand, use and reflect on a subject, **making use** of scientific language to become active and participative in social and professional practices”, while scientific literacy “relates to an individual making use of their scientific knowledge in broader society(p.2).

In other words, in the case of scientific literacy, the scope of competences must be broader and deeper, assuming a critical capacity in relation to concepts. Or, as expressed in this publication, “scientific literacy should prepare the individual for a change of personal attitudes and to question the direction of scientific and technological development.” From this perspective, scientific literacy refers to social function, for example, if

society knows the importance of vaccines because it believes that their use protects people from diseases that can be avoided, or as regards the use of medicines to keep healthy.

The concept of scientific literacy began to gain force from the 1990s and became prevalent in the field of science education in the last two decades, especially in documents regulating educational policies.

The stimulus to the educational development of individuals to become more capable of positioning themselves in the face of socially-relevant scientific themes is closely linked to ethical issues which may place our civilization in peril, such as the degradation of the environment and the possibilities of genetic change. The more the decision-making process about these themes is shared, the better.

To encourage this approach to education in general, the BNCC uses strategies that strengthen student's skills as they progress through school education and become older, so that their knowledge becomes broader, deeper and more secure.

The BNCC and its scope is close to the concept of scientific literacy

To argue from a basis of reliable facts, data and information, to formulate, negotiate and defend common ideas, points of view and decisions that respect and promote human rights, socio-environmental awareness and responsible consumption at local, regional and global levels, with ethical positioning in relation to the care of yourself, others and the planet. (BRAZIL, 2017).

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After the Pandemic

Managers of educational networks organize themselves to reformulate science curricula in the light of the BNCC.

Since 2017, when it was launched, the BNCC had already gone through revisions and improvements. It faced massive challenges as it started to be introduced in the country's education networks, many of them outside the field of education, the largest, but not unique, problem being the COVID-19 pandemic, which had a massive impact on the delivery of education throughout Brazil.

Camilla Souza Alo, Director of the Third and Fourth Educational Cycles (Primary Education 2) at the Municipal Department of Education of Nitreói (Rio de Janeiro State), for example, explains that the impact of the pandemic continues, with serious repercussions, such as food vulnerability, which have affected many students, and, of course, learning itself, today the target of a major recovery effort within the department. "Literacy is no longer restricted to the early years of primary education, it goes further. The initiative is not restricted to those who teach Portuguese but to every teacher, whatever their subject, because for us every teacher is a teacher of language. In this way,

science education can collaborate not only to overcome this problem, but also to train a critical, autonomous, responsible citizen who does not promulgate fake news," she explains.

Cláudio Furtado, Secretary for Education, Science and Technology for the State of Paraíba, talks about the importance of scientific literacy from when the student starts at school, so that there is no risk of "discussing things that we were already sure were true 2,000 years ago". Science should be part of children's everyday lives, he argues. "In Paraíba, our Science and Technology Weeks, the scientific literacy programmes, which are already very strong in secondary education, should be replicated in primary schools, as a form of scientific initiation which is already available when the pupil begins to respond to the 'whys'".

The first step in Paraíba focuses on the teachers: "We have run several INSET programmes for teachers from the state and municipal schools so that the idea of the new BNCC is increasingly internalized as a broader vision, impacting on

our large-scale evaluation schemes which not only look at the literacy of our pupils in Portuguese and Mathematics but also include science, so that we can measure how our pupils are performing against the benchmarks of international evaluations,” Furtado says.

In Niterói, the teacher awareness process began in 2019 and extended until the end of 2022. “We took a fresh look, collaboratively and in dialogue, at our curriculum, which was updated on the basis of the BNCC, but without ceasing to reflect on the reality of Niteroi and the questions that teachers judge important”, says Camilla Alô.

In addition to the issues of the curriculum, Furtado understands that it is necessary to engage with universities on the issue of scientific literacy, so that the teaching degree courses are in line with the BNCC. “With this approach, the risk of training professionals distant from the reality of schools is avoided,” he says.

Themes and approaches which are close to the heart of the BNCC approach, which focuses on project-based learning and problem solving, interdisciplinarity and group work, is already on the agenda in several initiatives. In Niterói, we have the STEAM (Science, Technology, Engineering, Arts and Mathematics) initiative and science clubs. In Paraíba, the Progame-se (Get Ready), aimed at girls, the Desafio Celso Furtado (Celso Furtado Challenge) and Ouse Criar (Be Creative) programmes stand out. They began in secondary schools but are starting to filter into primary schools.

Managers see these tools and approaches as essential for the student to develop the skills they will need in the 21st century, such as autonomy, self-confidence, problem-solving, working as a group, understanding their position in the group, emotional intelligence, and ability to mediate conflicts. The goal, says Furtado, “is for our pupils to become better citizens, prepared to stand up and demand a quality society.”

Challenges for Digital Education

For experts, improving connectivity, computer access, and teacher training play a key role in science education

Technological education as a tool should be understood as a skill that should not be restricted to the job market, but also seen as fostering a critical debate in society and optimizing the act of teaching and learning, where education is permeated by digital resources, where the teacher is the author and strategist who plans their didactic and pedagogical approach to include the use of technologies, customizing the teaching and learning process. From this perspective, computing, besides being of strategic importance in modern society, can be a strong support to the study of natural sciences.

In recent years, however, there has been a slight decline in the number of enrolments for Computing Science teacher training courses (see Table) in the data set selected for this publication. Between 2015 and 2019, there was a 0.6% decline in Computer Science enrolments (Higher Education Census). The largest drop in enrolments was in state and private universities, while federal universities experienced some growth (see Table).

According to Ana Paula Gaspar, an expert in educational technologies, this problem is also an issue elsewhere in the world. The explanations vary. “There are few universities that offer this course in Brazil and there is a drop in the number of those studying the subject. The reason is the same as for other teacher training degrees – the unattractiveness of a career in teaching. Add to this the competitive market for computing professionals in other areas, where salaries are much more attractive than in education”, she adds.

However, Ana Gaspar believes that this situation may change with the approval, in February 2022, of the Standards for Computing in Education, a supplement to the BNCC. On January 11, 2023, Federal Law 14,533 came into force, establishing the National Digital Education Policy. “This should create a clear demand for computing professionals in schools across the country.”

Labs

In the case of pupils in the final years of primary education, the percentage of those who have access to computer labs in their schools is much higher than for science labs. The data, however, only show that the laboratories exist, and not how they are equipped or are actually being used.

PERCENTAGE OF PUPILS IN THE FINAL YEARS OF PRIMARY SCHOOL WHO HAVE ACCESS TO SCIENCE AND COMPUTER SCIENCE LABORATORIES IN BRAZIL, BY ADMINISTRATIVE REGION*

REGION/ TYPE OF LABORATORY	SCIENCE	COMPUTING
CENTRE-WEST	28,1%	69,5%
NORTHEAST	16,6%	45,9%
NORTH	19,9%	53,7%
SOUTHEAST	41,6%	83,4%
SOUTH	57,7%	82,2%

* ACCORDING TO THE 2020 SCHOOL CENSUS.

“Today, when we talk about technology in schools, we are talking about the possibility of establishing virtual laboratories that allow students to simulate situations, to experiment to extend their knowledge of any subject. A science lab with all the equipment and other resources it requires, which are very costly, can now be set up almost anywhere as a virtual resource, provided there is access to the internet and computers” says Severa Lúcia Dellagnol, President of the Innovation Centre for Brazilian Education

(CIEB). The institution is a benchmark for the inclusion of technology in education.

From a recent conversation with Paulo Blikstein, a lecturer at Stanford University’s School of Education, Dellagnol reports that he talks about robotics labs as an excellent tool for problem-solving and pursuing practices that get pupils to carry out practical activities. “With low-cost kits and electronics available, a lot can be done. There are also several simulators and virtual chemistry and physics laboratories in which you can set certain parameters to see if an experiment works or not”.

For Ana Paula Gaspar, there are experiments that can be rolled out across the publicly-funded school networks, such as the project set up by the then-teacher Débora Garofalo, from the São Paulo municipal school system, which made use of scrap materials to teach robotics.

A relatively simple solution, it can be implemented using just the programme that makes funding available directly to schools (PDDE) and does not require the teacher, who is also their own administrator nowadays, to have a lot of prior knowledge. “Débora is a great example because she did not have any training in STEM, but managed to make the subject very relevant to her pupils”, says Ana Gaspar.

See also: Education of Girls and Women in STEM Areas, a UNESCO-organized webinar about incentives to increase their participation in Brazil. Access <https://www.youtube.com/watch?v=tFT2Xm2CYI8>

“Setting up a science lab with all the equipment and materials required, which is very expensive, can now be done virtually anywhere where there is access to the internet and computers”

**Lúcia Dellagnol, CEO of the CIEB
(Innovation Centre for Brazilian Education)**

Barriers

Teacher training, however, is one of the most serious obstacles to the use of technology in laboratories or in the classroom. On its website (www.cieb.net.br), CIEB includes the results of a self-assessment carried out by more than 100,000 Brazilian school teachers who do not feel that they are properly trained to use technology beyond what they do in their personal lives.

“When you ask them how they would use technological resources to teach or assess pupils, to curate digital educational resources, they openly say they have not received training and do not know how to do that,” says Lúcia Dellagnol. She then adds that they did not receive training in this when they studied for their teaching degree, or at INSET courses.

And there is another training obstacle to be overcome as soon as possible: most teachers say they do not know how to use technology for their own professional development, that is, how to make and use their own online courses or self-assessment tools. This is a skill that needs to


be developed if the various initiatives from educational leaders are to give real results.

Along with the issue of training, Brazilian schools also face infrastructure issues. There are two key issues which are holding back schools: low connectivity, a major problem for a country the size of Brazil, and the difficulty of getting access to computers, tablets, and other equipment and materials. To give an idea of the scale of the problem, countries which are part of the Organization for Economic Cooperation and Development (OECD) have an average of five pupils per computer, while in Brazil this number rises to 35 or more.

However, it should be pointed out that educational policies aimed at introducing technologies to schools have been in place in Brazil for more than three decades. One of the key actions was PROINFO (National Educational Technology Programme), officially launched by Administrative Action No. 522/MEC, back in 1997. Since then, despite several government initiatives launching programmes and actions aimed at technological education, there has been a lack of investment to ensure its continuity and expansion to all schools.

The Impact Factors

Even with these figures, Dellagnol warns that a balance between the various factors capable of generating a positive impact on education needs to be struck. There are countries, like



the United States, that invest large sums in technology, but achieve educational results that are considered poor.

“Smaller countries, such as Estonia, some regions of China, and Singapore, have made smaller investments in financial terms but have succeeded in making significant improvements in their educational results, with technology being key to this.”

Lúcia Dellagnol

A study carried out in the Netherlands by researchers from Kennisnet (www.kennisnet.nl), the country’s Education Technology Centre, shows that there are four factors that make a difference when they are in balance:

- A clear vision of why and for what to use technology
- Development of teacher and educational manager skills
- Good digital educational materials and resources
- Good school infrastructure

CIEB’s website explores Kennisnet’s material and includes a comparison of the technology policies of different countries. In addition, it includes a thorough examination of the digital skills of teachers. In addition, the CIEB team has created an instrument for use in Brazil called Guia EduTec (<https://guiaedutec.com.br/>) based on their material, which measures the extent to which technology is used in schools. The innovative aspect of this resource is that it evaluates the balance between the four pillars on the basis of the answers the schools provide on the site. According to the director of CIEB, more than 100,000 schools in Brazil have already applied the tool, which makes it possible to build a picture of the relationship between the different aspects.

The view of scientific research

Panorama includes a review of research focused on the analysis of science teaching; the main focus of the researchers is on teacher training and related issues.

A good indicator of what are the most important issues facing the teaching of the natural sciences in schools is the academic research being carried out into the topic. For this reason, the *Panorama* made an inventory of scientific articles based on those published in the SciELO electronic portal (Scientific Electronic Library Online), one of the most respected electronic scientific libraries in Brazil.

In the search, the term “science education” was used as the main descriptor, which resulted in a response of 281 articles. The next step involved associating other descriptors related to the main term. After a preliminary analysis, five themes were chosen by the Carlos Chagas Foundation research team for further study. They are:

- **Teacher training**
- **Methodologies and practices**
- **Curriculum**
- **Science literacy and scientific literacy**
- **Inequalities (rights and inclusion issues).**

For sociologist Sandra Unbehau, the research coordinator, these are the five main themes in the field. She emphasises that “issues such as the articulation between initial and continuing training in teaching methodologies and practices, lead us to a reflective, critical and participative approach to the role of science in society.”

Interconnections

When we look at the themes considered most relevant by the Panorama, it is appropriate to make connections between them. “Teacher training” is the key word most identified in the search and is linked to almost all the other themes. But not only. For example, the question of methodologies and practices, related to several keywords included in the second search filter (methodology, didactics, continuing training, curricula, among others), shows that there is a considerable interest in linking taught educational content to local realities and to real-world issues. “There is a need for this to be done critically, showing the historicity of knowledge, the relationships of people and these realities over time,” says Unbehau.

She emphasizes that a crucial issue for good science education is INSET, which should complement and update concepts for teachers in an ever-changing world with new discoveries. This permanent need for updating is not restricted to teaching, it is a contemporary issue.

Controversial Issues

The research also stresses, because of its importance, a fifth theme. However, according to the Panorama analysis, there are few research projects into the theme. These are the issues related to diversity, which the survey aimed to bring together under three aspects: gender and sexuality, ethnic and racial issues and inclusion.

The document alerts us to a surge of concern with gender issues, when related to sexuality, due to its political relevance and polarised positions. These issues end up not being addressed, or includes convictions not based on scientific knowledge, which does not contribute to the wider acceptance of social differences and diversity. This influences the writing of official documents, such as the BNCC, which underwent changes as it was drafted, as shown in one of the research projects cited.

What remains to be investigated

In evaluating the set of selected studies, Sandra Unbehau points to the total absence or infrequent presence of studies on topics that would contribute greatly to science teaching. The first of these is an in-depth investigation into what is happening in public sector schools and networks. How are the conceptual, curricular and methodological changes actually being implemented – or not? In addition, to what extent do the educational networks and the schools themselves interact today and, in the latter, how is the interaction between subject areas and management?

“Another area we need to look at is evaluation. In 2017, the School Education Assessment System (SAEB) applied a trial science test to 5th and 9th year students. The results were not good. This evaluation must be carried out regularly by SAEB”, Unbehau concludes, and more than that, strategies for improving the quality of science teaching should be examined.

Finally, she highlights the need for developing active methodological practices in education through INSET schemes and the exchange of teacher experiences, leading to scientific education based on actual experiences such as case studies, issue-based learning, project-based learning, the inverted classroom, hybrid learning and gaming. Anchored in these precepts, the classroom should be open to the possibility of reflecting knowledge, stimulating an interest in research, testing hypotheses and increasing the curiosity of children and adolescents, through interdisciplinary projects and practices involving real situations. This perspective helps extend the interest of the pupils and engages them as agents of their learning, as pointed out by several authors of the studies cited in the Panorama.



A Learning Snapshot

Find out about platforms designed to promote and support science learning and education initiatives

iNaturalist (www.inaturalist.org)
Portuguese - Helps identify plants and animals

Zooniverse (www.zooniverse.org)
English - Brings together volunteers and researchers for scientific projects

Anecdata (www.anecdata.org)
English - Supports the gathering, management and sharing of citizen science data

eBird (www.ebird.org/brasil)
Portuguese - For bird watchers, with tab for Brazilian species

Scistarter (www.scistarter.org)
English - International projects database supporting comparisons and queries.

GBIF - Global Biodiversity Information Facility (www.gbif.org)
English - International network and data infrastructure that gives access to data on the types of life on Earth

iSpot (www.ispotnature.org)
English - Helps identify species, learning and sharing information about nature.

Open Science Lab (<https://learn5.open.ac.uk/course/view.php?id=2>)
English - Online citizen science experiments.

Treezila (<https://treezilla.org/>)
English - Catalogue of the tree species in the United Kingdom and seek to estimate a value for what it calls “ecosystem services.”

The Stem Education Hub is a partnership between the British Council and King's College London, which seeks to encourage science teaching and learning, as well as to stimulate collaboration between Brazil and the United Kingdom on research fronts, training and innovation aimed at stimulating quality education for all.

Headquartered at the School of Education, Communication and Society (ECS) of King's College London, and opened in January 2021, the programme has partners in both countries who contribute with ideas and events. In addition, it offers opportunities for mobility, reflection, study and collective experimentation between the two countries in the STEM areas, strengthening the culture of using research evidence for a reflective educational action oriented toward the promotion of citizenship, of equity and sustainable development in school and higher education. Its activities also include the production and sharing of good teaching practices.

The STEM Education Hub in Action

- Production and sharing of knowledge about science teaching
- Scientific workshops
- International missions for building partnerships and carrying out collaborative work and studies
- Immersion courses and summer schools
- Lectures and seminars on emerging themes in the field of teaching and popularization of the sciences

The STEM Education Hub is open to new partnerships within its scope of action. Those interested in contributing should contact us at:





www.britishcouncil.org.br

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