Brazil

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Introduction

Overview of Education System

The Brazilian education system is organized to guarantee the right to education through the definition of responsibilities among the federative entities. It is a collaborative system that combines different levels of centralization and decentralization. School education can develop in public and private institutions, but basic education (*Educação Básica*) is mostly provided by public institutions, registering 81.1% of enrolled students in 2022.[1]

The Law on Brazilian Education Guidelines and Bases (9,394/1996)[2] determines that Brazilian school education is organized in two levels: (1) basic education, which comprises three stages: early childhood education (*Educação Infantil*) that includes day care and preschool for children ages 0 to 5, elementary education (*Ensino Fundamental*) that lasts for 9 years, and high school (*Ensino Médio*) that lasts for 3 years; and (2) higher education (*Educação Superior*). According to this law, the Union must organize, maintain, and develop the official departments and institutions of the federal education system, acting directly at the higher education level. The 26 Brazilian states and the Federal District are responsible for offering elementary education and, as a priority, high school. Municipalities must offer early childhood education in day care and preschools and, as a priority, elementary school. The states and

municipalities are responsible for hiring the majority of teachers who work in basic education, thus defining their remuneration and working conditions, which results in great disparity.

The Union, in collaboration with the states, the Federal District, and municipalities, is responsible for preparing the National Education Plan and establishing competencies and guidelines for early childhood education, elementary education, and high school, which guide the curricula and their minimum content, in order to ensure common basic education. It must also provide technical and financial assistance to the states, the Federal District, and municipalities to help them develop their education systems and prioritize the provision of compulsory education (4 to 17 years) as well as to ensure a national process of evaluation of student performance in elementary, high school, and higher education, in collaboration with the respective education system.[3]

The National Common Curriculum Base (BNCC) defines "the organic and progressive set of essential learning as the right of children, young people, and adults in the scope of basic education, and guides its implementation through the education systems of the different federative entities, as well as by school institutions or networks."[4] It presents natural sciences and mathematics as fields of knowledge, in which the curricular components must guarantee students the development of specific skills that are described year by year for the initial years (Grades 1 to 5) and the final years (Grades 6 to 9) of elementary education, through thematic units, objects of knowledge, and skills.

Use and Impact of TIMSS

Brazil participated in TIMSS for the first time in 2023. It is expected that TIMSS results will contribute to measuring mathematics and science skills of students in Grades 4 and 8. This, together with other national and international assessments, can support the process of implementing the BNCC (ongoing across the national territory) in addition to promoting the development of specific public policies.

The Mathematics Curriculum in Primary and Lower Secondary Grades

In 1997, the National Curricular Parameters (PCN) were developed as an initiative of the Ministry of Education of Brazil (MEC). However, although the PCNs played a fundamental role in guiding school curricula, they were not mandatory.

A discussion held in 2010 in a widely debated forum on education policies gave rise to the National Education Plan (*Plano Nacional da Educação* [PNE]).[5] Notably, within its 20 goals, four goals highlighted the necessity of creating a common minimum curriculum. Thus, in 2017,[6] the BNCC was born following extensive discussions among Brazilian citizens and educators. The BNCC refers to basic education and encompasses early childhood education, elementary education, and high school. Legitimized by the intergovernmental pact, according to Law 13,005/2014,[7] which enacted the PNE, the BNCC relies on proper functioning of the collaborative system to achieve its objectives. Serving as a national reference for the formulation

of curricula in the education systems and school networks of states, the Federal District, and municipalities, as well as the pedagogical proposals of school institutions, the BNCC, a legal normative document, integrates the national policy of basic education and serves as a reference for the development of curricula in all basic education schools, whether public or private. It contributes to aligning other policies and actions at the federal, state, and municipal levels.

Therefore, based on the BNCC as a guiding document for the curriculum and a movement called PRO/BNCC, states and municipalities have developed their own curricula. In this regard, each of the Brazilian states, the Federal District, and municipalities have curricula guided by the BNCC, but with individualized content.

The document establishes that various fields of mathematics are interconnected through fundamental concepts such as equivalence, order, proportionality, interdependence, representation, variation, and approximation. Thus, the BNCC for mathematics encompasses five thematic units—Numbers, Algebra, Geometry, Magnitudes and Measurements, and Probability and Statistics—that are interconnected to guide the development of skills throughout elementary school. This allows for these themes to be emphasized in a differentiated manner throughout each school year. A summary of the thematic units is as follows:

- Numbers—Students are expected to solve problems involving natural numbers, integers, and rational numbers, employing various strategies and understanding the mathematical processes involved. They should also manage calculations related to percentages, interest, and other financial operations, as well as the ability to recognize, compare, and order real numbers. Additionally, this curriculum unit addresses concepts of economics and finance to promote financial education and interdisciplinary connections with cultural, social, political, and economic themes, enriching their skills in financial mathematics.
- Algebra—The students' knowledge is deepened by exploring various meanings of variables, generalizations, investigating regularities in sequences, and solving equations with an emphasis on using the Cartesian plane. Furthermore, mathematics, including Algebra, Numbers, Geometry, and Probability and Statistics, contributes to the development of computational thinking, allowing students to translate situations into different mathematical languages, such as transforming problems into formulas, tables, and graphs. It is also relevant to mention the importance of algorithms and flowcharts as elements of study, representing complex procedures in a simplified and graphical form, related to algebraic language and aiding in the identification of patterns and generalizations.
- Geometry—This involves consolidating and expanding on previous learning, emphasizing tasks that involve transformations and changes in the size of flat geometric figures, focusing on the concepts of congruence and similarity. The integration of Algebra with Geometry from the Cartesian plane is essential, allowing for the expansion of activities related to coordinates and systems of linear equations. Geometry should not be limited to applying formulas but should include traditional

geometric approaches, such as the equivalence of areas, enabling the resolution of complex problems geometrically.

- Magnitudes and Measurements—Students are expected to recognize magnitudes such as length, area, volume, and angle in geometric figures and solve problems using standard units of measurement. They should also establish relationships between these magnitudes and others, including nongeometric magnitudes, to study derived magnitudes such as density and speed. Students should calculate the areas of quadrilaterals, triangles, and circles, as well as the volumes of prisms and cylinders. It is also important to introduce measurements of computer storage capacity, with the observation that the prefixes used (kilo, mega, giga) do not follow the decimal system of base 10 because, for example, a kilobyte is equivalent to 1,024 bytes, not 1,000 bytes.
- Probability and Statistics—This includes practical activities involving random experiments and simulations, allowing students to compare practical results with theoretical probability. This involves enhancing the ability to count elements in the sample space, especially in counting problems. Regarding statistics, students should learn to plan and create statistical reports that include measures of central tendency, tables, and graphs. This requires defining questions, identifying the population, deciding on the use of a sample, and, if necessary, selecting sample elements using an appropriate technique.

Each thematic unit comprises a set of skills, which, in turn, are associated with a set of knowledge objects. For Grade 8, students assessed in TIMSS 2023 were expected to study specific knowledge objects for each thematic unit (see Exhibit 1).

Exhibit 1: Mathematics Curriculum, Grade 8

Thematic Unit	Knowledge Objects
Numbers	• scientific notation • exponentiation and radical expressions • the multiplicative principle of counting • percentages • periodic decimals: repeating decimal fractions
Algebra	• functions: numerical, algebraic, and graphical representations • ratio between magnitudes of numeric value of algebraic expressions • association of a linear equation of the first degree with a line in the Cartesian plane • system of polynomial equations of the first degree: algebraic resolution and representation in the Cartesian plane • polynomial equation of the second degree of the form $ax2 = b$ • recursive and nonrecursive sequences • variation of magnitudes: directly proportional, inversely proportional, or not proportional

Exhibit 1: Mathematics Curriculum, Grade 8 (Continued)

Thematic Unit	Knowledge Objects
Geometry	• congruence of triangles and proofs of properties of quadrilaterals • geometric constructions: angles of 90°, 60°, 45°, and 30°, and regular polygons • medians and angle bisectors as geometric loci: construction and problems • geometric transformations: symmetries of translation, reflection, and rotation
Magnitudes and Measurements	• area of flat figures • area of the circle and length of its circumference • volume of a rectangular block • measurements of capacity
Probability and Statistics	• multiplicative principle of counting • sum of the probabilities of all elements in a sample space • bar, column, line, or sector charts and their constituent elements, and suitability for a specific set of data • organization of data from a continuous variable into classes • measurements of central tendency and dispersion • census or sample surveys • planning and execution of sample surveys

To correctly answer a mathematics assessment item, students need to be familiar with the mathematics content being assessed by the item. In this sense, the skills assessed in TIMSS are largely covered in the BNCC. However, in addition to familiarity with the content, students need a range of cognitive skills that support the mathematical thinking processes that are evaluated. The description of these skills plays a crucial role in both the curriculum and assessment, ensuring the coverage of cognitive competencies across the entire content domain.

Despite the advancements mentioned in terms of content and axes in the BNCC as compared to the PCNs from 1997, the BNCC generally addresses skills related to simpler cognitive domains, such as knowing. While these skills allow students to become familiar with mathematical concepts, they mainly focus on identifying, calculating, recognizing, reading, and recording. For example, among a group of 28 skills present in the BNCC for Grade 4, there is only one skill related to associating, two skills related to utilizing, and five skills related to problem-solving and development, accounting for about 28% of the total skills. Additionally, there is one skill related to analyzing data, representing about 3%, while the remaining 20 skills (approximately 75%) pertain to the cognitive domain of knowing.

This distribution differs from TIMSS, which points to 40% for the knowing cognitive domain, 40% for the applying cognitive domain, and 20% for the reasoning cognitive domain. Thus, analysis of the skills proposed in the BNCC suggests that its uneven distribution of skills in the cognitive domains compared to TIMSS may affect how Brazilian children perform on TIMSS.

The BNCC reveals progress from the PCNs from 1997, for example, by introducing Algebra in the first year of elementary education (Grade 1), involving figurative and numerical patterns, investigations of regularities, and recursive and repetitive sequences, among other topics. There is also progress in the Probability and Statistics axis, introducing concepts of chance and event classification in the first year of elementary education, and conducting small research activities that include data collection, organization of information, personal records, and presentation of results.

Additionally, the BNCC[8] reaffirms the need in this final stage of elementary education to gradually introduce students to understanding, analyzing, and evaluating mathematical arguments. This includes reading mathematical texts and cultivating a critical approach to the arguments present in them.

It is worth noting that the implementation of the BNCC was hindered due to the COVID-19 pandemic, even though schools in states, the Federal District, and municipalities attempted to adapt their curricula to the pandemic situation and develop materials that could be used online or distributed by mail to homes.

The Science Curriculum in Primary and Lower Secondary Grades

As mentioned, in 2017, the MEC approved the BNCC for all stages of basic education.[9] Even though it is an essential step toward quality education, the BNCC should not be confused with the curriculum. It is a normative document that defines the set of essential learning and has as its main objective the establishment of competencies and skills to be developed by students from all over the country throughout basic education.[10] The BNCC had several versions, and its development was marked by discussions, disputes, and controversies, along with many criticisms. However, as Brazil is a large country, the role of the BNCC is to be a mandatory reference for the elaboration and revision of basic education curricula in public and private schools, with the different legal and educational institutions being responsible for contextualizing curricular contents according to local and regional specificities.

In elementary education, the area of natural sciences (NS) encompasses knowledge of biology, physics, chemistry, geosciences, and astronomy and was the area that underwent the greatest modifications in the BNCC as compared to the previous curricular guidelines, requiring rearrangements of all didactic material for this teaching segment.

The competencies for science teaching in elementary education are divided into the following three thematic units:

- Matter and Energy
- Life and Evolution
- Earth and Universe

Exhibit 2 shows the organization of the BNCC for the NS area from Grades 1 to 8 of elementary education. The Contents column is based on the skills described in the official BNCC document.

Exhibit 2: Science Curriculum for Elementary Education (up to Grade 8)

Thematic Unit		Knowledge Objects	Contents
Grade 1	Matter and Energy	characteristics of materials	• characteristics, origin, use, and disposal of materials
	Life and Evolution	human body respect for diversity	• drawings and functions of body parts • habits of body hygiene and health • physical characteristics of people; diversity; appreciating, welcoming, and respecting differences
	Earth and Universe	time scales	• different time scales: days, weeks, months, and years • rhythm of activities of human beings and other beings according to days and nights
Grade 2	Matter and Energy	material properties and uses prevention of domestic accidents	• materials used to manufacture everyday and past objects, ways of using these objects • properties of materials and construction of objects • domestic accidents and necessary care
	Life and Evolution	living beings in the environment plants	• characteristics of plants and animals, relationships with the environment • importance of water and light for plants • parts of plants and their functions, relationships with the environment and other living beings
	Earth and Universe	apparent movement of the Sun in the sky the Sun as a source of light and heat	• Sun positions at various times and shadows projected • effects of solar radiation (heating and reflection) on different surfaces

Exhibit 2: Science Curriculum for Elementary Education (up to Grade 8) (Continued)

	Thematic Unit	Knowledge Objects	Contents
Grade 3	Matter and Energy	sound production effects of light on materials hearing and visual health	• production of sounds and variables that influence this phenomenon • effects of light on transparent, polished, and opaque objects • hearing and visual habits and health
	Life and Evolution	characteristics and development of animals	• characteristics of the way of life of animals in nearby environments • life cycle of terrestrial or aquatic animals, including man • organization of animals into groups based on external characteristics
	Earth and Universe	characteristics of Earth observation of the sky land uses	• characteristics of Earth evidenced by the observation and comparison of different forms of representation of the planet • daily periods when the Sun, other stars, the Moon, and planets are visible • characteristics of different soil types • different land uses
Grade 4	Matter and Energy	mixtures reversible and irreversible transformations	• mixtures: physical properties and composition • transformations in materials when exposed to variations in temperature, luminosity, and humidity • temperature variations and reversible and irreversible changes
	Life and Evolution	simple food chains microorganisms	• food chains and the role of the Sun as an energy source • similarities and differences between the cycle of matter and the flow of energy between the components of ecosystems • decomposing microorganisms and the environmental importance of decomposition • microorganisms and the production of food, fuels, and medicines, among others • transmission of viruses, bacteria, and protozoa and the prevention of diseases

Exhibit 2: Science Curriculum for Elementary Education (up to Grade 8) (Continued)

Thematic Unit		Knowledge Objects	Contents
Grade 4	Earth and Universe	cardinal points calendars, cyclical phenomena, and culture	• cardinal points from different relative positions of the Sun and the shadow of a stick (gnomon) • comparisons between indications of the cardinal points obtained by means of shadows of a stick (gnomon) with those obtained by compasses • motions of the Moon and Earth in the construction of calendars in different cultures
Grade 5	Matter and Energy	physical properties of materials hydrological cycle conscious consumption recycling	density, thermal and electrical conductivity, magnetism, solubility, responses to mechanical forces, among others • changes in the physical state of water; effects of the hydrological cycle on agriculture, climate, electricity generation, drinking water supply, and ecosystem balance • vegetation cover in the maintenance of the water cycle, soil conservation, water courses, and atmospheric air quality • role of water and other materials in daily activities, sustainable ways of using these resources • conscious proposals and technological solutions for proper disposal and reuse or recycling of waste
	Life and Evolution	nutrition of the body eating habits integration between digestive, respiratory, and circulatory systems	• digestive and respiratory systems: the function of nutrition in the body • circulatory system: distribution of nutrients and elimination of waste • balanced menu organization based on food group characteristics and individual health needs • nutritional disorders related to habits among children and young people

Exhibit 2: Science Curriculum for Elementary Education (up to Grade 8) (Continued)

Thematic Unit		Knowledge Objects	Contents
Grade 5	Earth and Universe	constellations and sky maps Earth's rotational motion periodicity of the phases of the Moon optical instruments	• use of features such as sky maps and applications for constellation identification • associations between the daily movement of the Sun and the other stars in the sky and the rotation of Earth • periodicity of the phases of the Moon • devices for remote (telescope, periscope, etc.) or magnified observation of objects (magnifiers and microscopes) or for recording images (cameras) and their social uses
Grade 6	Matter and Energy	homogeneous and heterogeneous mixtures separation of materials synthetic materials chemical transformations	• types of blends • evidence of chemical transformations from mixtures • separation of heterogeneous systems • production of medicines and other synthetic materials and scientific and technological development: socioenvironmental benefits and impacts
	Life and Evolution	cell as a unit of life interaction between locomotor and nervous systems corrective lenses shape, structure, and movements of Earth	• cell: morphofunctional unit of life • organization of living beings from systems • nervous system: structures and their functions in the motor and sensory coordination of the body • functioning of the human eye and types of lenses for correcting vision defects • muscle, bone, and nervous systems in the structure, support, and movement of animals • psychoactive substances and the nervous system
	Earth and Universe	shape, structure, and movements of Earth	• Earth's layers (from internal structure to atmosphere) and their characteristics • rock types, fossil formation, and geological periods • evidence of Earth's sphericity • relative movements between Earth and the Sun (rotation, translation, and tilt of Earth's axis of rotation relative to the plane of its orbit around the Sun) and changes in the shadow of a stick (gnomon)

Exhibit 2: Science Curriculum for Elementary Education (up to Grade 8) (Continued)

	Thematic Unit	Knowledge Objects	Contents
Grade 7	Matter and Energy	simple machines ways of heat propagation thermodynamic balance and life on Earth history of fuels and thermal machines	• simple machines throughout history and solutions for everyday mechanical tasks • differences between temperature, heat, and thermal sensation • heat propagation and use of thermally conductive and insulating materials • thermodynamic balance in the maintenance of life on Earth, in the operation of thermal machines, and in other everyday situations • socioenvironmental problems caused by thermal machines and their different fuels • technology and changes in both everyday life and the world of work
	Life and Evolution	diversity of ecosystems natural phenomena and environmental impacts public health programs and indicators	• Brazilian ecosystems • impacts on ecosystems caused by natural disasters or changes in their physical, biological, or social components • conditions of human populations based on health indicators (such as infant mortality rate, basic sanitation coverage, and incidence of waterborne and atmospheric diseases, among others) and public policies • the action of the vaccine in the body and its historical role in the maintenance of individual and collective health and for the eradication of diseases • historical role of technology based on environmental and quality of life indicators
	Earth and Universe	air composition greenhouse effect ozone layer natural phenomena (volcanoes, earthquakes, and tsunamis) plate tectonics and continental drift	• air characteristics and phenomena that altered its composition • greenhouse effect and global warming • ozone layer and its relations with life on Earth • relationships between volcanoes, earthquakes, and tsunamis and plate tectonics; occurrence of these phenomena in Brazil • relations between the Brazilian and African coasts based on the drift of the continents

Exhibit 2: Science Curriculum for Elementary Education (up to Grade 8) (Continued)

	Thematic Unit	Knowledge Objects	Contents
Grade 8	Matter and Energy	energy sources and types energy transformation electric energy consumption calculation electric circuits conscious use of electrical energy	• types of energy: renewable and nonrenewable • electric circuits • energy transformations in residential electrical equipment • monthly consumption of household appliances • optimization of electricity consumption in a sustainable and responsible manner • types of electric power generation plants and their socioenvironmental impacts
	Life and Evolution	reproductive mechanisms sexuality	• reproductive processes in plants and animals in relation to adaptive and evolutionary mechanisms • sex hormones and nervous system at puberty • contraceptive methods and responsible use for the prevention of pregnancy and sexually transmitted infections (STIs) • symptoms, transmission, prevention, and treatment of some STIs (emphasis on AIDS) • human sexuality (biological, sociocultural, affective, and ethical)
	Earth and Universe	Sun, Earth, and Moon systems weather	• Moon phases and eclipses • Earth's rotation and translation movements, related to the seasons of the year • determinants of regional climates: atmospheric and oceanic circulation, uneven warming, and Earth's movements • weather forecast and its variables • environmental interference due to regional and global climate change caused by humans

Teacher Professional Development Requirements and Programs

The Law on Brazilian Education Guidelines and Bases (9,394/1996)[11] determines that basic education teachers should have an undergraduate teaching degree, although completing regular high school is accepted as a minimum requirement for teaching at the early childhood education level and for teaching the first five grades of elementary education. Regarding the professional development of teachers, this law indicates that the education systems should promote the valorization of education professionals by ensuring their entry exclusively by

open competitive examinations and qualifications (e.g., tests and CV); continuous professional development; professional minimum salary; career progression based on degree or training and on performance evaluation; a period reserved for studies, planning, and evaluation included in the workload; and adequate working conditions. Given the decentralization of the Brazilian federal system, these conditions vary greatly in relation to municipalities and states.

According to the 2022 school census,[12] Brazil has 114,150 mathematics teachers for Grade 4 and 73,446 for Grade 8; there are 111,971 science teachers for Grade 4 and 62,071 for Grade 8. In addition, 72% of mathematics teachers and 71.7% of science teachers of the first years of elementary education (up to Grade 5) have an undergraduate teaching degree (or a bachelor's degree with pedagogical supplementation) in the same discipline they teach. In the final years of elementary school (Grades 6 to 9), these percentages are 66.3% for mathematics teachers and 66% for science teachers.

Regarding continuous professional development programs, two actions exclusively aimed at practicing mathematics and science teachers stand out at a national level. The professional master's degree program Mathematics in a National Network is a hybrid program offered by a network of universities through the Open University of Brazil and the Coordination for the Improvement of Higher Education Personnel (CAPES) and is coordinated by the Brazilian Society of Mathematics with support from the National Institute of Pure and Applied Mathematics (IMPA). Created in 2011, it is present in all states of Brazil. Another initiative, created in 2023, is the online specialization course Science Is 10, which is offered by CAPES. It involves 18 higher education institutions and is aimed at science teachers who teach Grades 6 to 9 in public schools.

Monitoring Student Progress in Mathematics and Science

In 1990, Brazil established the National Basic Education Assessment System (*Sistema de Avaliação do Ensino Básico*, or SAEB), which assesses students in the final years of each school cycle: Grade 5 and Grade 9 of elementary school and the final (third) year of high school. As of 2021, students have also been assessed in Grade 2 of elementary school, which is the period when literacy is completed as defined by the BNCC. The PNE indicates that children should be literate by the end of Grade 3.[13] In this sense, the Grade 2 assessment is sample based, and the other SAEB assessments are census based. These assessments take place every 2 years.

The purpose of SAEB is to contribute to the improvement of public education in Brazil, offering concrete input for the formulation, reformulation, and monitoring of public policies. Mathematical literacy assesses understanding and application of mathematical concepts and procedures, as well as problem-solving and argumentation in the fields of Numbers, Algebra, Geometry, Magnitudes and Measurements, and Probability and Statistics.

The cognitive processes used are as follows:

- understanding and applying concepts and procedures: tools with which mathematics is done (includes recognizing mathematical objects, making connections between mathematical concepts and procedures, and using different representations)
- solving problems and arguing: using tools to do mathematics

In the SAEB framework, what is meant by "solving problems" in mathematics is in line with the definition proposed by the National Pact for Literacy at the Right Age: operations in problem-solving for a mathematical problem that "is a situation that requires the discovery of unknown information in order to obtain a result. In other words, the solution is not available at first, but it is possible to construct it."[14]

It includes analyzing the plausibility of a problem; constructing, analyzing, or evaluating (making value judgments about) arguments, strategies, explanations, and justifications; and constructing or evaluating proposals for intervention, among others. The contents assessed are the same as in the BNCC:

- Numbers
- Algebra
- Geometry
- Magnitudes and Measurements
- Probability and Statistics

For the NS area, in elementary school, SAEB was administered in line with the BNCC for the first time in 2019 and again in 2021 only for Grade 9 in both years. In 2023, the assessment was administered again for Grade 9 and, for the first time, for Grade 5. The contents assessed in SAEB since 2019 are the same as those in the BNCC:

- Matter and Energy
- Life and Evolution
- Earth and Universe

The NS area is also monitored through regional large-scale assessments that are carried out by some municipalities and some Brazilian states.

The National Institute of Educational Studies and Research (INEP) is also responsible for implementing international educational assessments. Until 2023, the following two programs were used:

- The Regional Comparative and Explanatory Study (ERCE) is a periodic assessment for the countries of Latin America and the Caribbean, in which Brazil has participated since it began in 1997. In the NS area, Grade 7 is tested.
- The Programme for International Student Assessment (PISA) provides information on the performance of 15-year-old students, when compulsory basic education ends in most countries. It assesses three domains—reading, mathematics, and science—in every edition or cycle.

In addition, states and municipalities have their own assessments, which are sometimes diagnostic, sometimes for the purpose of monitoring, and sometimes designed to help improve the system. Some states, such as Ceará and São Paulo, have well-established assessment systems (SPAECE [System of Permanent Assessment of Basic Education] in Ceará and SARESP [System of Academic Performance Assessment of São Paulo State] in São Paulo). Even when states and municipalities have their own assessments, students take part in these assessments, as well as SAEB.

Thus, in addition to tracking student progress, assessment systems allow for the monitoring of education systems and adjustments to improve the learning of Brazilian students.

Special Initiatives in Mathematics and Science Education

Initiatives to improve mathematics teaching quality and student learning are generally offered by states and municipalities. Some states, such as Ceará and São Paulo, have offered continuous training and support materials to math teachers, discussing the assessment frameworks and SAEB results. Based on results, teachers are offered support materials with discussions about skills and examples of activities that can be developed to improve the education offered to students.

Other states, such as Alagoas and Piauí, also have had initiatives to discuss the assessment frameworks and in 2023, made specific preparations for students, both in terms of motivation to take the assessment and in terms of learning.

There have been online lectures that discussed the SAEB framework, which included participation from various states in the country. These lectures were organized by groups or foundations that provide continuous teacher training.

A full-time school program was created in 2023 by Law 14,640/2023[15] with the purpose of expanding full-time education at all stages of basic education, supporting schools in line with the BNCC. Initiatives like this can support skills and abilities that should be developed in elementary school, including in the area of mathematics.

The Brazilian Mathematics Olympiad for Public and Private Schools (OBMEP) is a national project run by the IMPA and in 2023, the 18th edition was held for students in Grade 6 through the final grade of high school.

The Women in Science Award, which, in 2023, had its 18th edition, is offered by the L'Oréal Group in partnership with the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the Brazilian Academy of Sciences (ABC).[a] The program encourages gender equality in science by rewarding innovative projects carried out by women.

In 2024, as an initiative to serve high-achieving students, Brazil will have a college dedicated to mathematics, innovation, and technology called IMPA Tech. As a social organization linked to

a See https://www.loreal.com/pt-br/brazil/news/grupo/grupo-loreal-no-brasil-anuncia-vencedoras-do-para-mulheres-na-ciencia-2023/ for more information.

the MEC and the Ministry of Science, Technology and Innovation (MCTI), IMPA Tech will offer a 4-year bachelor's degree course free of charge.

Science education is stimulated by government programs and the private sector in Brazil, both at the federal level and in a targeted manner in states and municipalities. These programs can be aimed at training teachers or directly at students; in both cases, the main objectives are to stimulate scientific education and improve students' scientific literacy. An example of federal government action is the online course Science-Based Literacy (ABC), the result of an international partnership with Portuguese institutions. In Brazil, the MEC, CAPES, and the Federal University of Goiás (UFG) are taking part, with support from the Open University of Portugal (UAB).

Another initiative at the federal level, carried out between 2019 and 2022, was the Science at School program (PCE), which aimed to improve science teaching in a collaborative effort by the Ministry of Science, Technology, Innovation and Communications (MCTIC); MEC; the National Council for Scientific and Technological Development (CNPq); and CAPES.

Different programs are implemented by education and research funding agencies, such as state research foundations and teaching and research institutions, especially CAPES, CNPq, universities, and the Oswaldo Cruz Foundation. Some private sector institutions also promote similar programs. Some examples of programs include the following:

- HackGirls 2023, with cultural management by Sociedade de Promoção da Casa de Oswaldo Cruz (SPCOC), is part of Fiocruz's Women and Girls in Science Program.
- The initiative called There's a Girl in the Circuit aims to awaken interest in university and specific areas of knowledge among elementary school girls. It develops hands-on workshops that combine craft elements with conventional electronic components, bringing the playful and creative aspect into a scientific context.
- The Digital Girls program publicizes the area of computing and its technologies to arouse the interest of girls in basic education so that they can learn more about the area and become motivated to pursue a career in computing.
- Shell NXplorers is a science education program that uses investigative methodology in which students try to recognize problems linked to sustainability in their schools and communities.
- The Scientific Vocation Program is aimed at high school students and practiced by different teaching and research institutions in partnership with schools.

In addition, National Science Olympiads have also boosted students' interest in science. Different aspects of scientific knowledge are promoted in the Olympiads, including science, physics, chemistry, biology, astronomy and astronautics, oceans, and science and art.

Suggested Reading

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