Romania

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Introduction

Overview of Education System

Romania has a centralized education system, currently governed by Education Act 1 of 2023.[1] All key responsibilities for education strategy, policy, and delivery—from preschool to vocational education and training—are concentrated within the Ministry of Education (MoEd). The education system is organized and led in partnership or in coordination with institutions that specialize in curriculum development, assessments and examinations, quality assurance, and other areas.

Schools in Romania have some autonomy over the curriculum, but the degree of flexibility is very limited. School maintenance is the responsibility of local authorities.

Exhibit 1 presents an overview of the national education system.

Exhibit 1: Structure of the Romanian Education System

<table>
<tr><th colspan="2">ISCED 0</th><th>ISCED 1</th><th>ISCED 2</th><th colspan="2">ISCED 3</th><th>ISCED 4</th><th>ISCED 5–8</th></tr>
<tr><td colspan="2">not compulsory</td><td colspan="2">compulsory</td><td colspan="2">not compulsory</td><td colspan="2"></td></tr>
<tr><td colspan="2">early childhood education
ages 0–5</td><td>primary education
ages 6–11</td><td>lower secondary education
ages 11–14</td><td colspan="2">upper secondary education
ages 14–18/19</td><td>tertiary nonuniversity education</td><td>tertiary education</td></tr>
<tr><td rowspan="2">nursery</td><td rowspan="2">kindergarten</td><td rowspan="2">preparatory year
Grades 1–4</td><td rowspan="2">Grades 5–8</td><td colspan="2">high school</td><td rowspan="2">post-high school
2 years</td><td rowspan="2">bachelor’s studies
3 years</td></tr>
<tr><td>Grades 9–10</td><td>Grades 11–12/13</td></tr>
<tr><td colspan="4"></td><td colspan="2">professional education
3 years</td><td></td><td>master’s studies
2 years</td></tr>
<tr><td colspan="6"></td><td>PhD studies
4 years</td></tr>
</table>

Education is delivered in both public and private schools or in alternative education systems (e.g., Waldorf, Montessori, Step-by-Step)[2] in the official state language (Romanian), in the native languages of students belonging to national minorities, or in modern languages.[3] Mobility of students from one field of study to another or from one pathway to another is allowed.

The national curriculum includes two components: (1) the core curriculum, which is a common and compulsory offering established at the national level for all students; and (2) the school-based curriculum, which is a set of education processes and learning experiences that every school develops and implements directly for its own students. The main purpose of the national curriculum is to equip all students with a set of competencies defined at different levels of generality.

Use and Impact of TIMSS

Along with data from other international assessments, TIMSS data and analyses raise policymakers' awareness concerning the effectiveness of education policies, structural problems facing the system, and the necessity for change at the curriculum level and in teaching practice. TIMSS results help education authorities understand the importance of reshaping continuous and national assessments and exams according to the requirements of the competency-based curriculum and good international practices.

The 2023 Act of Education (Education Act 1) introduced new mandatory assessments for preuniversity education at the end of Grades 2, 4, and 6, where students submit written assessments in language and communication (Romanian) and mathematics and science. Generally, the tests assess how well students have mastered the factual and procedural knowledge taught according to school mathematics and science curricula.

The Mathematics Curriculum in Primary and Lower Secondary Grades

Mathematics education has a prominent place in the Romanian national curriculum. Mathematics is taught throughout all stages of education and, together with Romanian language and mother tongue, is a core subject covered by the national assessments and baccalaureate. According to the national curriculum, at the primary and lower secondary levels, mathematics education aims to build students' understanding of the nature of mathematics as a problem-solving activity based on a body of knowledge and procedures that can be approached by exploration. Mathematics is not taught in isolation but in correlation with technology, natural sciences, and social sciences, as well as everyday life.

As of 2024, the mathematics curriculum in Romania is competency based, aiming at developing a set of general and specific competencies that, together with all other subjects, contribute to the development of eight key competencies that follow European Union recommendations.[4]

Despite emphasis on modifying mathematics teaching and learning in recent years, the provisioned reforms have not reached most teachers and students due to various changes in education policies over the last decade and weak professional development programs for teachers. Consequently, the reforms have not effectively influenced student learning.

According to the teaching plan for students assessed in 2018–2019,[5] mathematics is part of the curriculum area Mathematics and Natural Sciences. In the preparatory year and Grades 1 and 2, mathematics and science are taught together as an integrated subject called Mathematics and Environment Exploration for four periods (i.e., teaching hours) per week in the preparatory year and Grade 1 (21% of the total number of periods)[a] and five periods per week in Grade 2 (25% of the total number of periods). Four periods are allocated to mathematics in Grades 3 and 4 (25% of the total number of periods).

The mathematics curriculum for the preparatory year and Grades 1 and 2 is approved by Minister Order 3418/2013,[6] while the curriculum for Grades 3 and 4 is regulated by Minister Order 5003/2014.[7] This new generation of subject curricula brings principles of a competency-based curriculum, active learning, and a student-centered approach to the classroom; however, the impact of the new curricula has been diminished by weaknesses in teacher training programs.

Exhibit 2 presents the general and specific competencies related to mathematics at the end of primary education (Grade 4).

Exhibit 2: Competencies at the End of Primary Education (Grade 4)

General Competency	Specific Competencies
1. Identifying relations/ regularities in familiar settings	1.1 explaining patterns to create your own thinking 1.2 generating repetitive patterns
2. Using numbers in computations	2.1 recognizing natural numbers from 0 to 100,000 and fractions with a denominator smaller or equal to 10, respectively equal to 100 2.2 comparing natural numbers from 0 to 1,000,000 and fractions having the same numerator or the same denominator smaller or equal to 10 or a denominator equal to 100 2.3 ordering natural numbers from 0 to 1,000,000 and fractions with the same numerator or the same denominator smaller or equal to 10 or the denominator equal to 100 2.4 adding and subtracting natural numbers from 0 to 1,000,000 or fractions 2.5 multiplying natural numbers from 0 to 1,000,000 or fractions when factors have at least three digits and dividing with one- or two-digit numbers

a This analysis refers to the core/compulsory curriculum, not the school-based curriculum.

Exhibit 2: Competencies at the End of Primary Education (Grade 4) (Continued)

General Competency	Specific Competencies
3. Exploring geometric features of objects in familiar settings	3.1 locating objects in space and symbols in a variety of representations 3.2 exploring features, relationships, and properties of one-, two-, and three-dimensional shapes identified in various contexts
4. Using conventional standards in measurements and estimates	4.1 using standardized measurement tools and units in real-life contexts 4.2 operating with standardized measurement units, using transformations
5. Solving problems in familiar settings	5.1 using mathematical symbols and specific terminology to solve and propose a variety of problems 5.2 organizing data in tables and representing them graphically

According to the mathematics curriculum, to develop these competencies, teachers should favor classroom activities that emphasize the following:

- problem-solving activities requiring active involvement in practical contexts and searching for solutions beyond the given frame of school knowledge
- formulating questions, analyzing steps, and motivating decision-making in problem-solving
- using various motivational strategies to help learning
- working in teams
- using assessments as a part of learning

Graduates of primary education should be able to show curiosity to find scientific truths, explore patterns and mathematical relations in familiar contexts, formulate simple explanations using specific mathematical terminology, and solve problems in familiar situations using mathematical tools and/or procedures.

Mathematics education for students in Grades 5 to 8 who were assessed in 2018–2019 is regulated by Minister Orders No. 3638/11.04.2001[8] and No. 5097/09.09.2009.[9]

According to the approved teaching plan, four periods (i.e., teaching hours) per week are allocated for mathematics, representing 17% of the total number of compulsory periods per week, the highest allocation compared with any other subject except for Romanian language in Grade 5.

Exhibit 3 presents the general and specific competencies related to mathematics at the end of lower secondary education (Grade 8).

Exhibit 3: Competencies at the End of Lower Secondary Education (Grade 8)

General Competency	Specific Competencies
1. Identifying dates and mathematical relations and their correlations depending on the context in which they were defined	1.1 identifying real numbers and abbreviated calculation formulas in examples, exercises, or problems 1.2 recognizing correspondences that are functions 1.3 recognizing and describing properties of two-dimensional geometric shapes in given configurations, in space, or on their deployments
2. Processing quantitative, qualitative, structural, or contextual data in mathematical statements	2.1 using the definition of real number ranges and their representation on a number axis in exercises 2.2 using values of functions to solve equations and inequalities 2.3 using adequate geometrical tools to represent geometric shapes in two-dimensional shapes 2.4 computing areas and volumes of studied geometric shapes
3. Using mathematical algorithms and concepts for local or global characterization of a concrete situation	3.1 choosing the form of representation of a real number and using algorithms to optimize the computation with real numbers 3.2 representing correspondences and/or functions to characterize them 3.3 using properties of straight lines and angles in space to analyze their relative positions 3.4 classifying geometric shapes according to given or chosen criteria
4. Expressing quantitative and qualitative characteristics of real-life situations and of processing algorithms	4.1 using terminology related to the concept of real numbers (sign, module, opposite, reverse, whole part, fractional part) in a variety of contexts; using standardized measurement tools and units in real-life contexts 4.2 representing notions of plane geometry through graphic representations 4.3 representing concepts related to straight lines and angles in a plane and in space through geometric representations 4.4 expressing properties of figures and geometric shapes in mathematical language (axioms, direct theorem, reciprocal theorem, hypothesis, conclusion, demonstration)
5. Analyzing and interpreting mathematical characteristics of problematic situations	5.1 deducing and applying shortened calculation formulas for optimizing computations 5.2 determining solutions of equations, inequalities, or systems of equations 5.3 choosing appropriate geometric representations to optimize descriptions of spatial configurations and to optimize calculations of segment lengths and angle measurements 5.4 analyzing and interpreting the conditions necessary for a geometric configuration to verify certain requirements

Exhibit 3: Competencies at the End of Lower Secondary Education (Grade 8) (Continued)

General Competency	Specific Competencies
6. Creating mathematical patterns in problematic contexts by integrating knowledge from various domains	6.1 solving problems using real number reports represented by letters and interpreting the result 6.2 identifying problems that are solved by means of equations, inequalities, or systems of equations, solving them, and interpreting the result 6.3 interpreting geometric representations and information contained therein in correlation with the determination of segment lengths and angle measurements 6.4 transposing a problem into geometric language, solving the problem, and interpreting the result

The Science Curriculum in Primary and Lower Secondary Grades

During the primary education cycle, the science curriculum is delivered mainly through two subjects: natural sciences and geography. The main method of teaching is by exploring the immediate environment, then gradually increasing the scale to encompass more distant realities. The world is considered through its observable aspects and phenomena. Exhibits 4 and 5 present the general competencies developed and the achievement standards for fourth grade set out by the two curricula.

Exhibit 4: Competencies and Achievement Standards for the Natural Sciences Curriculum in Primary Education[10,11]

General Competencies, Grades 3 and 4	Curricular Achievement Standards, Grade 4
• understand and be able to communicate using specific scientific concepts and terminology • design and develop experiments, making use of specific instruments and procedures • develop an interest in and feel responsible for environmental sustainability	• identify similarities, differences, and relationships among objects and system components based on observation • classify objects, events, and phenomena based on specific criteria • describe relationships among systems and system components • communicate about experimental results and about objects, phenomena, events, and systems observed in a variety of ways • use conventional and unconventional instruments and tools for measurement, and identify patterns while measuring or observing phenomena • conduct basic experiments grounded in hypotheses or working plans

Exhibit 5: Competencies and Achievement Standards for the Geography Curriculum in Primary Education[12]

General Competencies, Grade 4	Curricular Achievement Standards, Grade 4
• represent geographic space (from local to global) • establish connections between geographical elements based on different sources • make adequate use of language specific to geography • exhibit behavior conducive to improving relationships between humans and the environment	• identify observable elements of nearby geographic space • classify observable elements of the environment • identify relationships between observable elements and represent them on simple cartographic media • describe a reality based on images • identify basic relationships based on observation or a variety of sources • employ basic terms in given contexts

Students starting school during the 2012–2013 academic year have benefited from updated school curricula. The achievement standards are no longer part of each curriculum and are instead set out by the Graduate's Profile[13] with specific descriptors for Grades 4, 8, and 10. They were developed starting with the first iteration of the eight key competencies.[14] Exhibit 6 presents the general science competencies for the primary education cycle.

Exhibit 6: General Competencies for Natural Sciences and Geography in Primary Education

Subject	General Competencies
Natural Sciences, Grades 3 and 4	• explore characteristics of bodies, phenomena, and processes • investigate the environment using specific instruments and techniques • solve daily life problems by employing acquisitions regarding one's own body and the environment
Geography, Grade 4	• present the observable environment by employing general and specific terminology • use important elements from mathematics, natural sciences, and social sciences in understanding the environment • connect the environment with a cartographic representation • develop an interest in knowing the local horizon, that of the country, and that of the contemporary world

At the end of fourth grade, students should have achieved the following basic competencies in science and technology:

- follow a simple investigative process by going through a series of steps to achieve a goal

- create simple products, with adult support, for the regular needs of one's own learning activities
- exhibit interest in one's own health and in a clean environment
- apply basic rules for personal hygiene and rules for responsible behavior toward the environment

For the lower secondary cycle, the science curriculum branches out to four subjects: biology, geography, physics, and chemistry. Building on previously acquired exploration competencies, the science curriculum moves toward a more systematic approach, focused on experiments and analysis of data collected. The curriculum aims to foster a positive attitude of engagement with one's own needs and with the environment, to develop a healthy lifestyle, and to create environmental awareness. Exhibits 7 to 10 present the general competencies developed by the lower secondary science curricula and their respective achievement standards.

Exhibit 7: Competencies and Achievement Standards for the Biology Curriculum in Lower Secondary Education[15]

General Competencies, Grades 5 to 8	Curricular Achievement Standards, Grade 8
• acquire information about the living world • explore biological systems • use and develop models and algorithms to demonstrate principles of the living world • communicate orally and in writing, using correct terminology • transfer and integrate specific knowledge and methods of biology in new contexts	• use terminology and concepts correctly to describe and interpret biological processes • identify, interpret, and classify structural and functional properties of organisms • carry out research on the living world by correctly applying investigative methods • identify a problem and select correct methods and means to solve it • interpret and comment on data collected while carrying out an experiment and draw conclusions from the data • present one's own research activities verbally or in writing • select and use appropriate sources of information

Exhibit 8: Competencies and Achievement Standards for the Chemistry Curriculum in Lower Secondary Education[16]

General Competencies, Grades 7 and 8	Curricular Achievement Standards, Grade 8
• explain chemical phenomena, processes, and procedures from daily life • investigate how substances and chemical systems behave • use deductive and inductive approaches to problem-solving • explain and report results of investigations • evaluate consequences of using chemical processes and chemical products	• classify simple and complex substances, mixtures, and chemical reactions according to one or more criteria • describe and interpret chemical phenomena, properties, and models • experiment using known substances • represent and interpret observations and data resulting from research and experiments in the form of tables, graphs, and diagrams • draw conclusions based on the physical and chemical behavior of substances • apply mathematical relations and expressions of the laws of chemistry to solve quantitative problems • use scientific terminology when presenting a piece of research orally or in writing

Exhibit 9: Competencies and Achievement Standards for the Physics Curriculum in Lower Secondary Education[17]

General Competencies, Grades 6 to 8	Curricular Achievement Standards, Grade 8
• know and understand physical phenomena, concepts, laws, and models, and be able to explain the function and use of technical devices in daily life • investigate experimentally and theoretically • solve problems using procedures specific to physics • communicate using scientific terminology • protect oneself, others, and the environment	• describe observed physical phenomena using specific terms • use measuring equipment and specific methods to determine physical quantities • carry out experiments, either controlled or not, based on physical phenomena • organize, use, and interpret data from experiments • interpret the content of a problem from the perspective of physics, quantitatively • use mathematical relations and principles and the laws of physics to solve theoretical or practical problems • use physics terminology to describe observations and conclusions drawn from experiments • understand the overall meaning of physics-related information from various sources

Exhibit 10: Competencies and Achievement Standards for the Geography Curriculum in Lower Secondary Education[18]

General Competencies, Grades 5 to 8	Curricular Achievement Standards, Grade 8
• use correct terminology to present and explain geographic reality • use names and terms in different languages • transfer knowledge from mathematics and science to environmental studies • represent geographic reality on maps • identify and explain social, civic, and cultural aspects of a geographic space • acquire skills and techniques for lifelong learning • develop patterns and solutions for organizing a geographic space, taking into consideration sustainable development	• define the position of basic elements in space and time • connect elements of real geographic space with their symbolic representations • use information from maps and drawings to represent a geographic reality • write a report on a topic related to geography • use information and communications technology (ICT) to find geographic information

Teacher Professional Development Requirements and Programs

Continuous professional development of mathematics, science, and technology teachers is achieved through courses that offer transferable professional credits. Courses can be focused on areas such as mathematics, sciences and technology, pedagogy, educational psychology, didactics, ICT, and education management.

The 2023 Act of Education brought changes related to initial and continuous training of teachers, focusing on professionalizing the teaching career with very clear training profiles and increasing the quality of initial training.

Teachers of primary education have to graduate from a pedagogical university for a teaching career. Teachers of lower and upper secondary education have to graduate from a faculty in the job profile, complete a psycho-pedagogical training module (30 European Credit Transfer and Accumulation System [ECTS] credits), and complete a 1-year teaching master's degree program that includes 80% practice.

One new initiative to support new teachers as a result of the 2023 Act of Education is through the establishment of the Mentoring and Teaching Licensing Corps, whose objective will be to define and implement clear training profiles for each didactic function.

Regarding continuous training every 5 years, teachers must obtain five credits based on the national plan for continuous training in the teaching career, five credits obtained for courses in correlation with the specifics of the school community served, and five credits at the discretion of the teaching staff.

Monitoring Student Progress in Mathematics and Science

Mathematics is a national assessment subject for students in Grades 2, 4, 6, and 8. While national assessments for Grades 2, 4, and 6 are meant to provide students, parents, and teachers with formative feedback, the Grade 8 national assessment is used to prepare students for upper secondary education. The fourth-grade evaluation is also intended to provide a systemic overview of student achievement after the primary cycle. It is important to mention that the sixth-grade assessment includes natural sciences.

All national assessment tests are designed by the National Centre for Assessment and Examinations (MoEd) in accordance with the national curriculum, but scoring is done either in-house (for evaluations in Grades 2, 4, and 6) or across several schools (for the fourth-grade evaluation). All students assessed in TIMSS 2023 participated in these national assessments.

Mathematics and science teachers are responsible for designing and conducting classroom evaluation according to the general regulations of the MoEd.

Student evaluation should be performed regularly by classroom teachers using methods that they consider most appropriate (e.g., oral questioning, written papers, practical activities, reports and projects, interviews, portfolios).

Evaluations are graded at the primary level with a qualitative mark on a 4-point scale (insufficient, sufficient, good, and very good) and at the lower secondary level with a quantitative mark on a 10-point scale that is recorded in the class record. Every school semester, teachers assign a certain number of marks to each student; the number must be at least equal to the number of classes per week established by the national curriculum for the given subject and grade. At the end of each semester and school year, teachers calculate and record the average mark/qualitative mark for each student and subject.

Special Initiatives in Mathematics and Science Education

In recent years, the MoEd has implemented various programs for improving and modernizing the curriculum for primary and secondary education, focusing on integrated science subjects with real-life examples and contexts. An important change is the modification of the national assessment at the end of Grade 8 that introduces a cross-disciplinary test of mathematics and sciences. However, the educational measure has not yet been implemented because teacher training has not taken place; another factor contributing to this delay is changes to teaching in science classrooms.

At the national level, initiatives and programs focused on science education from nongovernmental organizations (NGOs) include the following:

- The Romanian Space Agency (ROSA) program uses the concept of “cosmic space” as a creative context for integrated teaching and learning in science, technology, engineering, and mathematics (STEM) in preuniversity educational institutions in Romania. The European Space Education Resource Office (ESERO) organizes

national events regarding STEM education in the context of cosmic space, as well as training for primary and secondary teachers.

- Programs from the Centre for Evaluation and Educational Analysis (CEAE) are updating and modernizing the curriculum for physics and chemistry at the secondary level through inquiry-based learning (IBL) methods. CEAE has organized accredited training courses for physics and chemistry teachers, created methodological guides for teaching physics, and developed an online platform for physics teachers with best practices and instruments to be used in classrooms.
- Community Education for Science programs, such as National Conference and Magurele Summer School of Science and Technology, support the exchange of ideas and best practices in science education through learning communities and ecosystems that support professional development and guidance for students.

To improve the education process, the MoEd is implementing the School After School program, in tandem with the compulsory school program. The School After School program offers opportunities for consolidating competencies, remedial learning, and accelerating learning through educational, recreational, and leisure activities.

Suggested Reading

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