Cyprus

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Introduction

Overview of Education System

Education governance in Cyprus is centralized, with overall responsibility resting with the Ministry of Education and Culture (MoEC). The MoEC is responsible for the administration of education, the enforcement of laws, and the implementation of education policies, as well as the preparation of the education budget.[1] The MoEC sets out public school curricula and textbooks for all subjects. The Educational Service Commission, an independent five-member body, is responsible for appointments, secondments, transfers, promotions, and discipline (including dismissal) of public school teachers. Autonomy at the school education level is very limited.

School education is provided through preprimary, primary, and secondary institutions. Compulsory education lasts 10 years and extends from age 4 years, 8 months (preprimary education) to age 15 (lower secondary education). Public education is free for all students in the age range of 4 years, 8 months to 18 years.

Preprimary education includes the education of children age 3 to 5 years, 8 months in public, community, and private schools.[2] Preprimary education is compulsory for children age 4 years, 8 months to 5 years, 8 months.[3]

Primary education (Grades 1 to 6) is provided for children age 5 years, 8 months to 11 years, 8 months in public schools. Secondary education (Grades 7 to 12) for students age 12 to 18 in public schools includes two 3-year levels: the gymnasium (lower secondary education, Grades 7 to 9) and the lyceum (upper secondary education, Grades 10 to 12).[4] The gymnasium comprises general education, whereas the lyceum (which has adopted a different structure since 2015–2016) allows a course selection system. Beyond the common core subjects, students at Grade 10 can choose one group of subjects out of four (4 teaching periods per week) and one direction (out of six) at Grades 11 to 12 (16 teaching periods per week).[5] As an alternative to the lyceum, students may attend secondary technical and vocational schools in two directions.[6]

Although the majority of students enroll in public schools, some children attend private schools; in 2016–2017, this percentage was 9.0 percent for primary and 18.1 percent for secondary schools.[7] Private schools fall into three categories: (1) schools "of the same type" follow public school curricula, (2) schools "of similar type" follow public school curricula by two-thirds (that is,

two-thirds of the major subjects offered in public schools are taught in these schools, with respect to time and subject content), and (3) schools "of a different type" do not belong to these two categories[8] and implement a curriculum and timetable that corresponds to the education system of a different country.[9]

Use and Impact of TIMSS

TIMSS 2019 is the sixth TIMSS cycle in which Cyprus has participated, following participation in 1995, 1999, 2003, 2007, and 2015. Since 2015, the country participates in TIMSS through the Centre of Educational Research and Evaluation (CERE). The CERE disseminates the results of the study to stakeholders and the public through the presentation and publication of relevant documents (e.g., the TIMSS National Report[10]). The release of TIMSS results is followed by local media coverage that stimulates extensive public discussion on the performance of Cypriot students, especially in comparison to students of other countries.

The results of Cyprus in previous TIMSS cycles led the MoEC to form committees to prepare recommendations about improving learning outcomes.[11]

The Mathematics Curriculum in Primary and Lower Secondary Grades

This section focuses on the mathematics national curriculum, implemented in the vast majority of schools—i.e., all public schools and private schools "of the same type." The main focus of the curriculum is to prepare students to acquire essential mathematical knowledge and competencies, in ways that meet the needs of each individual as a constructive, concerned, and reflective citizen. Moreover, the curriculum focuses on the development of students' mathematical reasoning, conceptual understanding, problem solving skills, procedural knowledge, and positive attitudes toward mathematics. An integrated approach from preprimary to secondary education is adopted on the basis of four principles: (1) students should be involved in mathematical investigations that enhance their curiosity and interest; (2) emphasis should be given to problem solving; (3) Information and Communications Technology (ICT) should constitute an integral part of mathematics education; and (4) students' experiences should be enhanced through pedagogically rich activities arising from active and meaningful engagement with mathematical problems and concepts.[12]

In the 2018–2019 school year, mathematics instruction at the primary level was allocated 7 teaching periods per week (out of 35) in Grades 1 to 4, and 6 periods in Grades 5 to 6.[13] At the gymnasium, the respective teaching periods were 5 per week (out of 38) in Grade 7 and 4 in Grades 8 to 9.[14]

Exhibits 1 and 2 outline the mathematics curriculum for Grade 4 and Grade 8, respectively, that was in effect during the 2018–2019 school year.[15,16]

Exhibit 1: Fourth Grade Mathematics Curriculum

Units	Topics
Numbers and Operations	▪ Read, write, represent, compare, and order whole numbers up to 1,000,000 ▪ Round whole numbers up to 100,000 ▪ Perform mental addition and subtraction with numbers up to 10,000 ▪ Estimate and calculate addition and subtraction with whole numbers up to 100,000 ▪ Develop and apply standard algorithms for addition and subtraction with whole numbers up to 1,000,000 ▪ Perform mental multiplication and division ▪ Develop and apply standard algorithms for multiplying multiple-digit whole numbers by one-digit whole numbers ▪ Develop and apply standard algorithms for dividing multiple-digit dividends by one-digit divisors ▪ Understand and use the concepts of divisor, dividend, remainder, factor, and multiple ▪ Understand the criteria of divisibility for 2, 5, and 10 ▪ Solve and pose routine problems involving addition and multiplication ▪ Solve nonroutine problems using multiple strategies (e.g., logical reasoning, working backward, trial and error, using materials, making a table, looking for patterns, making a drawing, and simplifying the problem) ▪ Understand the concept of fractions as parts of a whole and as parts of a set of discrete objects ▪ Calculate parts of a whole number ▪ Understand fraction equivalence ▪ Compare and order fractions and decimal numbers with up to two decimal digits ▪ Use fractions to represent units ▪ Add and subtract like fractions ▪ Read, represent, and compare decimals with up to two decimal digits ▪ Convert between decimal numbers and fractions with a denominator of 10 or 100
Measurement	▪ Use conventional units of measurement for length (mm, cm, m, km), mass (kg, g), capacity (l, ml), and volume (m^3, cm^3) ▪ Relate units of measurement for length (1 m = 100 cm = 1,000 mm), mass (1 kg = 1,000 g) and capacity (1 L = 1,000 ml). ▪ Measure the area and perimeter of rectangles and squares using the appropriate formulas ▪ Measure the area of right triangles ▪ Use decimals to represent quantities of money ▪ Relate units of measurement for time (e.g., year, decade, and century) ▪ Solve problems involving the relationship between hours and minutes

Units	Topics
Geometry	▪ Identify and construct right, acute, and obtuse angles in two-dimensional shapes ▪ Identify and name parallel and perpendicular lines ▪ Identify parallel and perpendicular sides in two-dimensional shapes ▪ Identify, name, and describe polygons using appropriate terms ▪ Identify and name parallelograms ▪ Classify shapes based on their sides (e.g., parallel or perpendicular) and angles (e.g., specified or unspecified magnitude) ▪ Identify and name three-dimensional shapes (e.g., cube, rectangular prism, prism, pyramid, sphere, cylinder, and cone) using appropriate terms ▪ Identify faces, edges, and vertices ▪ Identify and match nets with specific three-dimensional shapes ▪ Identify and construct the line symmetry in two-dimensional shapes ▪ Identify, complete, and construct symmetrical shapes (with a horizontal or a vertical line of symmetry) ▪ Describe the position of an object ▪ Give a sequence of instructions related to position using the language of position and movement
Algebra	▪ Identify, complete, and generate patterns ▪ Describe the rule of patterns ▪ Build numerical and figural patterns ▪ Model problems using mathematical expressions with a symbol for the unknown number ▪ Solve and pose routine problems involving additive and multiplicative structure with one or two operations ▪ Solve nonroutine problems ▪ Use the commutative and associative properties of addition and multiplication and the distributive property of multiplication to simplify calculations and verify results ▪ Use the distributive property of multiplication (along with addition and subtraction) to calculate products
Statistics and Probability	▪ Interpret and construct bar charts, tables, and picture graphs using a legend ▪ Interpret pie charts ▪ Order events based on their possibility of occurrence using the concepts “impossible,” “less possible,” “equally possible,” “possible,” and “certain”

Exhibit 2: Eighth Grade Mathematics Curriculum

Units	Topics
Real Numbers	▪ Properties of exponents where the index is a natural number ▪ Rational numbers raised to integer exponents ▪ Square and cubic roots ▪ Properties of roots ▪ The Pythagorean theorem
Algebraic Expressions	▪ Monomials ▪ Operations with monomials ▪ Polynomials ▪ Addition of polynomials ▪ Multiplication of polynomials ▪ Division of polynomials
Geometry	▪ Symmetry ▪ Parallelograms ▪ Orthogonal parallelograms ▪ Rhombuses ▪ Squares ▪ Trapezoids ▪ Circumference of a circle ▪ Area of a disk
Equations and Inequalities	▪ First order equations in one variable with one parameter ▪ Solving formulas for a given variable ▪ Properties of inequalities ▪ First order inequalities ▪ Solving simultaneous inequalities, interval presentation
Functions	▪ Relations and functions ▪ Linear functions, lines ▪ Special cases of linear functions ▪ Slope of a line ▪ Linear systems of two equations with two unknowns
Proportional and Inversely Proportional Quantities	▪ Proportional quantities ▪ Inversely proportional quantities
Statistics and Probability	▪ Measures of central tendency (mean, median, and mode) ▪ Statistics with spreadsheets ▪ Experimental probability—the basic counting principle

Private schools "of similar type" or "of a different type" approach mathematics in different ways, in terms of the curricular content and the periods allocated to the subject, often ranging from 3.5 to 8 teaching periods per week.[17]

The Science Curriculum in Primary and Lower Secondary Grades

This section focuses on the science national curriculum implemented in most of Cyprus—i.e., in public schools and private schools "of the same type." In primary education, the structure and content of the curriculum is based on two axes: (1) acquiring knowledge and constructing concepts related to everyday experiences, enabling students to formulate interpretations of the phenomena they observe in their environment, and (2) developing skills, attitudes, and behaviors toward competencies that are useful both for everyday life and lifelong learning.[18] The development, as well as the application of the learning content, is based on the principles of various theories and procedures, such as constructivism and inquiry-based learning.[19]

Since the 2011–2012 school year, science at the primary level is taught as Science and Technology in Grades 1 to 4, and as Science in Grades 5 to 6. Science in Grades 1 to 6 is allocated 2 teaching periods per week (out of 35).[20]

Exhibit 3 presents the science curriculum for Grade 4 in effect during the 2018–2019 school year.[21]

Exhibit 3: Fourth Grade Science and Technology Curriculum

Units	Topics
Life Science—Plants	▪ Plant transpiration and factors that influence it ▪ Adaptation mechanisms of plants and animals that help them survive in their environment ▪ Cyprus ecosystems and the importance of their conservation ▪ Sea, river, and lake pollution ▪ Waste management and recycling
Human Body	▪ Musculoskeletal system
Electricity	▪ Simple electric circuits ▪ Conductors and insulators ▪ Technologies for generating electricity; their strengths and weaknesses
Light	▪ Rectilinear propagation of light ▪ Transparency of materials ▪ Shadow formation and factors that influence the size of shadows
Heat and Temperature	▪ Water phase changes during heating or cooling ▪ Water cycle ▪ Phase changes of other materials
Matter	▪ Mixtures and solutions ▪ Factors that influence the dissolution time ▪ Separation of water solutions into their constituents ▪ Composition of air ▪ Air pollution
Earth Science	▪ The Solar System

In secondary education, the four science cognitive domains (Physics, Chemistry, Biology, and Geography) constitute distinct entities of the curriculum, each with a separate slot in the school timetable.[22] Earth Science does not appear as a distinct curriculum subject but as part of the

Geography curriculum.[23] Physics and Chemistry are introduced in Grades 8 to 9, with 2 teaching periods and 1 teaching period per week, respectively (out of 38).[24] Biology and Geography are introduced in Grade 7 with 2 teaching periods and 1 teaching period per week, respectively. Teaching time for Biology is one period in Grade 8 and 2 periods in Grade 9, while time for Geography is 1 period in Grade 8.[25]

Physics aims to help students develop an overview of key concepts; appreciate essential aspects of scientific inquiry; develop competence with the use of relevant technical equipment and apparatuses; draw on their accumulated experiences with the science processes to inform their way of thinking more broadly; develop positive attitudes toward science; identify applications of science in daily life and appreciate the interactions between science, technology, and society; and appreciate how engagement with science could help people shift away from prejudices.[26]

Chemistry draws on student-centered, inquiry-based approaches with a view to actively engage students in the learning process. Teaching aims to help students develop their own understanding of chemistry-related concepts and reasoning skills. The units not only focus on the cognitive domain but also seek to help students develop positive attitudes toward chemistry learning by drawing connections between the concepts they are taught and everyday experiences.[27]

Biology aims to promote six components of science learning: conceptual understanding, epistemological competence, attitudes, reasoning skills, and practical and scientific skills, as well as experiences. In addition, Biology aims to address students' misconceptions and alternative ideas. The learning materials for both Biology and Geography (Earth Science) are organized in a way that promotes innovative pedagogical approaches, such as inquiry, problem solving, cooperative learning, constructivism, and field work/experimentation. Different activities enable students' active involvement in the learning process, emergence of students' ideas, reconstruction of students' ideas, implementation of new ideas, and review of new ideas. Through collaborative learning, students are expected to develop communication and collaboration skills, as well as democratic citizenship.[28, 29]

Exhibits 4, 5, 6, and 7 present the Grade 8 curriculum for Physics,[30] Chemistry,[31] Biology,[32] and Geography,[33] respectively, that was in effect during the 2018–2019 school year.

Exhibit 4: Eighth Grade Physics Curriculum

Units	Topics
Scientific Method and Measurements	▪ Acquaintance with physics ▪ Concepts and measurements ▪ Fundamental measurements and scales (length, mass, and time) ▪ Derivative measurements and scales (area, volume, density)
Motion in one Dimension	▪ Reference point, frame of reference, position, time interval, distance traveled, displacement, scalar and vector quantities ▪ Speed and velocity ▪ Lab activity: measuring the speed of a car ▪ Uniform motion ▪ Motion diagrams: position, time and velocity, and time ▪ The slope of a position-time graph represents the velocity ▪ Identifying nonuniform motion ▪ Average acceleration
Forces	▪ The nature of force: a quantity measuring a push or a pull on an object; force Is a vector quantity ▪ Measuring forces ▪ Representing a force ▪ Types of forces: contact and noncontact ▪ Hooke's law ▪ Estimating the resultant force: adding collinear forces ▪ Newton's First Law ▪ Newton's Second Law ▪ The force of gravity ▪ Newton's Third Law
Pressure	▪ Pressure and force: explaining everyday phenomena ▪ Definition of pressure ▪ Pressure in fluids ▪ Variation of pressure with depth in fluids ▪ Pressure measurements ▪ Buoyant force and Archimedes' principle ▪ Floating and sinking objects

Exhibit 5: Eighth Grade Chemistry Curriculum

Units	Topics
Introduction	▪ Contribution of chemistry to the evolution of civilization ▪ Familiarity with laboratory environment
Matter and the Structure of Matter	▪ The importance of water in our lives ▪ Mixtures ▪ Methods of separation of mixtures ▪ Solution: solvent and solute ▪ The chemical composition of water, electrolysis of water ▪ Chemical elements and compounds ▪ Atoms and molecules ▪ Chemical formulas ▪ Atomic structure, atomic number, mass number ▪ Electron arrangement in shells ▪ Valence, ions ▪ Chemical reactions

Exhibit 6: Eighth Grade Biology Curriculum

Units	Topics
Discovering Our Nutrition	▪ Nutrition and organisms ▪ Nutrition habits and health ▪ Experiments: detecting nutrients in foods
Exploring Our Digestive System	▪ Structure and function of the digestive system ▪ Structure, function, diseases of the digestive system ▪ Mechanical digestion of foods from cell to cellular organelles and macromolecules ▪ How do food macromolecules break down? ▪ Chemical digestion; digestive enzymes from macromolecules to micromolecules ▪ Absorption of nutrients ▪ Nutrient energy
Studying our Circulatory System	▪ Circulatory system structure ▪ Structure and function of the heart ▪ Structure and function of blood vessels ▪ The course of blood in the human body ▪ Blood and its components

Exhibit 7: Eighth Grade Geography Curriculum

Units	Topics
Europe	▪ Location ▪ List of physical features ▪ List of climatic factors, vegetation belts ▪ List of the causes of extreme weather conditions
Europe—Many Entities	▪ EU member states, non-EU member states ▪ Physical, economic, social, and cultural features of the Mediterranean Region; people of the Mediterranean Region ▪ Environmental threats the Mediterranean Sea faces ▪ Location of Danube River, Danubian countries ▪ Physical, economic, social, and cultural features of the Danubian countries ▪ Environmental threats to Danubian countries ▪ Implementation of "European Rights" in the Mediterranean Region
Sustainable Development	▪ Reduce, Reuse, Recycle ▪ Sustainable management of waste
Economic Geography	▪ Economic sectors, employment
Globalization	▪ Related terms ▪ Disadvantages

Private schools "of similar type" or "of different type" approach science in different ways. Most of them teach science as an integrated course; some provide biology, chemistry, and physics as distinct subjects; and some provide instruction for geography separately. The content of these subjects varies across schools. Important variation is also noted with regard to the number of teaching periods allocated for these subjects.[34]

Professional Development Requirements and Programs

The MoEC is responsible for organizing in-service training for teachers mainly through the Cyprus Pedagogical Institute.[35] The institute offers compulsory and optional programs for teachers of all levels. These programs include courses, school-based seminars, conferences, and workshops[36] that may address any subject thematically, including mathematics and science. Another means of supporting teachers' professional development includes the implementation of the professional learning strategy.[37] All schools are expected to prepare a professional development action plan focusing on a specific issue, set as a priority, according to teachers' and students' needs. The enactment of this plan includes school-based training as well as school-based activities.[38] This strategy is not restricted to science or mathematics teaching.

In addition, primary school teachers who teach science or mathematics are supported by the respective inspectorate of the MoEC through training events at the school level, as well as regional training events or seminars.[39,40] Similarly, secondary school teachers for mathematics and the four science subjects are supported through compulsory or optional training/ empowerment seminars.[41,42,43,44,45]

Private primary and secondary schools set their own selection criteria for recruiting teaching staff, but they often follow the methods of appointment of the public schools and recruit teaching personnel from the "waiting list" of the Education Service Commission.[46]

Monitoring Student Progress in Mathematics and Science

In primary education, assessment is considered an integral part of teaching, and aims to improve student progress, teacher effectiveness, and the curriculum itself.[47] Teachers are required to adopt a systematic approach to student assessment, employing different assessment types and techniques. Students are assessed based on the extent of their class participation, their results on oral and written tests prepared by their classroom teachers, and their results on work done in the classroom and at home, including project work. Three types of assessment are administered at the primary level in Cyprus: (1) initial, or diagnostic; (2) formative, or continuous; and (3) final, or summative. Students do not receive grades or report cards but are awarded a school leaving certificate at the end of the Grade 6.[48]

In secondary education, both formative and summative evaluations are used to assess students.[49] At the gymnasium, assessment of student learning takes the form of daily informal evaluation of students' participation, short written tests, long written tests, home assignments, and projects. At the end of each school year, students take final examinations in four subjects—modern Greek, history, mathematics, and science—graded on a numerical scale from 1 to 20. Continuous assessment evaluations at the lyceum level are graded on a scale from 1 to 20 and supplemented by final examinations. At the end of Grade 10, students take a written examination in four subjects—modern Greek and three other subjects, according on the group of subjects chosen,[50] while at Grades 11 to 12, students are examined in modern Greek and four other subjects, according to the direction they follow.[51,52] Final examinations are written and administered by schools. The Pancyprian Examinations administered at the end of secondary education (Grade 12) are prepared centrally and implemented by the Examination Department of the MoEC.[53] The Pancyprian Examinations serve both as final school examinations and entrance examinations for the public universities in Cyprus and Greece.[54]

In August 2016, the MoEC completed a proposal on the modernization of the student assessment system that suggests changes and new regulations concerning the public schools from the preprimary to the lower secondary education level.[55] Since September 2017, continuous assessment shifted from a nominal scale system (with grades ranging from A to E) to a numerical scoring scale ranging from 1 to 20.[56]

Special Initiatives in Mathematics and Science Education

An important reform introduced in 2014–2015 includes the revision and restructuring of the national curriculum for all subjects and grades on the basis of attainment and adequacy targets.[57] Attainment targets refer to the learning outcomes, expected to be achieved by the end of each

grade, whereas adequacy targets describe what needs to be taught for the outcomes to be achieved.[58] As a result, the respective teaching/learning materials were revised; in many cases, these materials are still undergoing iterative refinements to better address the relevant attainment/adequacy targets and accommodate feedback from teachers.

During 2015–2016, a revised school timetable was implemented in public primary[59] and secondary schools,[60] involving minor differentiations in the distribution of teaching periods per subject. Specifically, at the primary school level, the number of the teaching periods for mathematics increased by two periods for Grades 1 to 4 and one period for Grades 5 to 6.[61] The subsequent increase for this subject at the gymnasium level was one teaching period for Grades 7 to 8. Changes were not made to the overall teaching time for science, except for a redistribution of teaching periods for Grade 8 biology and geography: time increased by one teaching period for the first subject and decreased by one teaching period for the second.

The application of the new curriculum and timetable aimed to strengthen the validity of the public school leaving certificate and ensure a more reliable system of access to public higher education institutions in both Cyprus and Greece.[62]

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