Lithuania

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Introduction

Overview of Education System

In Lithuania, parliament defines the basic principles, structures, and objectives of education, while the Ministry of Education, Science, and Sport devises and implements education policy through various subordinate institutions. The Ministry of Education, Science, and Sport defines the curriculum and determines teacher salaries, requirements for teacher qualification, priorities for developing teacher education, assignment of education staff, and requirements for heads of schools.

Primary and basic schools follow a national curriculum that schools and teachers are expected to adapt to their particular needs. Local municipalities are responsible for administering and financing most general education and vocational schools, with the exception of national level schools. The administration of nonformal education is decentralized under the jurisdiction of local municipalities and includes extracurricular activities, optional curriculum hours, and the establishment of nonformal schools and their curricula (e.g., music, sports, and art). The municipalities also are responsible for the assessment of schools, administrators, teachers, professional development, and student achievement.

The levels of education in Lithuania are divided according to ISCED (International Standard Classification of Education) 2011. Early childhood education and care (ECEC) in Lithuania from age 0 to 5 is optional. Compulsory education is for students ages 6 or 7 to 16. Upper secondary school comprises Grades 11 and 12. Gymnasia form a parallel system of education lasting four years and corresponding to Grades 9 to 12. Currently, public schools are being reorganized into three types: primary schools (Grades 1 to 4), pre-gymnasia (Grades 1 to 8, or Grades 5 to 8), basic school (Grades 1 to 10, or Grades 5 to 10), and gymnasia (Grades 9 to 12, or I–IV gymnasium grades).

The mathematics and science curricula in Lithuania do not differ according to school type or education track.

The Minister of Education, Science, and Sports of the Republic of Lithuania approved the Guidelines for the Renewal of the General Curriculum in 2019.[1] The guidelines were presented and discussed with the education community. The General Curriculum of primary, basic, and secondary education will be updated according to these guidelines. Considering the overview of

the current situation, the main directions of the renewal of the General Curriculum are reinforcing the development of individuals' values and raising the highest achievement level for each student.

In Lithuania, the official national language is Lithuanian. In most schools, the language of instruction is Lithuanian, but in a considerable number of schools, the language of instruction is the mother tongue of the majority of the school's student population—usually Russian or Polish. In a small number of schools, the language of instruction is German, English, French, Belarusian, or Ukrainian. All schools with a language of instruction other than Lithuanian teach Lithuanian as a second language and the official national language. In primary and basic schools, which include the fourth and eighth grades, respectively, mathematics and science are taught in the school's language of instruction.

Use and Impact of TIMSS

Following the TIMSS 2011 report, which drew attention to science laboratories in primary and basic schools (Grades 5 to 8), Lithuania decided to equip all schools with scientific cabinets and establish 10 open access centers dedicated to science, technology, engineering, the arts and mathematics (STEAM). Centers will be equipped with science laboratories for students in formal and nonformal education. Lithuania also established the national Science and Technology Popularization Centre.

The Mathematics Curriculum in Primary and Lower Secondary Grades

The current mathematics curriculum in Lithuania was approved in 2008. According to the national curriculum, mathematics education in primary school (Grades 1 to 4) aims to help students develop calculating, reasoning, and formalizing skills, as well as visual, spatial, and statistical thinking.[2] The curriculum is based on the premise that understanding and applying mathematical concepts, models, methods, and relationships will enable students to better understand the world, solve everyday life problems, and adopt a culture of human thought and action that was developed over centuries. Knowledge gained in various mathematical content areas will help students orient themselves in everyday life and prepare for further studies in mathematics, the natural sciences, and technology.

Student skill objectives include communicating and collaborating using mathematical concepts as a means of conveying information, using mathematical vocabulary and symbols, adopting elements of mathematical reasoning, and learning to solve simple problems from everyday life that correspond to personal experience and interests. Students are expected to develop an appreciation of the importance of mathematics in their own lives and the lives of others, and its applications in various spheres of practical human endeavor. Overall, the curriculum aims to help students grow to value the honesty, perseverance, and creativity needed for intellectual work, and aspire to additional mathematical knowledge and skills.

The primary school curriculum comprises several mathematics content areas: numbers; expressions, equations, and inequalities; geometry; measurement; and statistics. When studying

numbers, students focus on developing their skills in mental and written calculations to learn the names and components of arithmetic operations and the concepts of numbers, digits, and fractions (however, students do not apply arithmetic operations to fractions in primary school). Exhibit 1 summarizes the knowledge content and specialized skills students learn in mathematics in Grades 3 to 4.

Exhibit 1: Mathematics Learning Objectives and Expectations, Grades 3 to 4

Content Area	Objectives and Expectations
Numbers	- Read and write natural numbers up to 10,000; simple fractions with denominators of 2, 3, 4, 5, 6, 7, 8, 9, 10, and 100; and decimal fractions with no more than two digits after the decimal point - Compare numbers of the same type, correctly using symbols, such as <, >, or = - Identify how close a given number is to a multiple of 10, 100, or 1,000 - Carry out practical counting tasks - Add and subtract natural numbers, multiply and divide by one-digit and two-digit numbers, and round three-digit and four-digit numbers (e.g., 100 or 1,000) - Solve simple real life and abstract problems, and estimate and check the results of calculations - Explain the appearance of remainders from division in the context of concrete situations
Expressions, Equations, and Inequalities	- Calculate values of simple numerical expressions or quantities - Depict everyday practical and mathematical situations using simple numerical expressions - Use the commutative and distributive properties of addition and multiplication when rearranging simple numerical expressions - Solve simple equations and inequalities using more than one variable by guessing the answer and checking the result
Geometry	- Recognize and draw points, segments, triangles, rectangles, squares, circles, cubes, parallelepipeds, pyramids, cones, and spheres - Show elements of triangles and rectangles (e.g., side, angle, and vertex) in models and sketches - Show radii of circles, and edges, vertices, and walls of cubes, parallelepipeds, and prisms in sketches - Identify symmetry in objects or geometric plane figures - Apply knowledge of plane and solid figures to solving simple problems
Measurement	- Read and write measurement results correctly - Draw segments of a given length, rectangles of given dimensions, and circles of a given radius - Estimate parameters of simple objects (e.g., length, width, and volume in liters) without using measuring instruments - Solve simple problems in which measurements are needed to carry out operations - Use calendars and schedules - Calculate average speed given distance and elapsed time - Calculate perimeter of triangles and quadrilaterals and area of rectangles
Statistics	- Collect data from the surrounding environment and display in frequency tables - Read information from bar graphs, pictograms, and frequency tables, and represent given (or collected) data in bar graphs - Answer simple questions and draw simple conclusions based on given (or collected) data

The basic education curriculum (Grades 5 to 10) emphasizes acquiring knowledge of various mathematical content areas for use in everyday life and building a strong foundation for the study of other subjects, such as the natural sciences and technology. Student skill objectives include communicating and collaborating, using mathematical vocabulary and symbols, adopting elements of mathematical methods and reasoning, conducting mathematical investigations in everyday life, solving mathematical problems, and understanding and applying mathematical relationships.

The curriculum conveys the need for students to understand the historical evolution of mathematics, and to explore ideas about modern areas of mathematics that might contribute to advances in natural, social, and computer sciences. Students should recognize the importance of mathematics for society, its objectivity, and its practical applicability in various areas of human activity. Mathematics instruction in Grades 5 to 10 aims to motivate students to seek mathematical knowledge and develop openness, perseverance, positive attitudes toward change, willpower, motivation, and responsibility. It emphasizes the need for students to learn and remain interested in other subjects that are built on a mathematical foundation.

The basic education curriculum divides mathematical knowledge and skills into the following content areas: Numbers; Expressions, Equations, Inequalities, and Their Systems; Relationships and Functions; Geometry; Measurement; Statistics; and Probability Theory. The curriculum further divides general skills and attitudes into knowledge and understanding, mathematical communication, mathematical reasoning, problem solving, and the ability to learn and develop interest in mathematics. Exhibit 2 summarizes the knowledge content and specialized skills students learn in mathematics in Grades 7 to 8.

Exhibit 2: Mathematics Learning Objectives and Expectations, Grades 7 to 8

Content Area	Objectives and Expectations
Numbers	- Read, write, and compare rational numbers, place them on a number line, round them to a specified digit, and use them in arithmetic calculations - Raise rational numbers to a whole number power - Find square or cube roots of rational numbers - Continue to develop problem solving skills involving percentages - Use a calculator to carry out various calculations and to check results
Expressions, Equations, and Inequalities	- Calculate values of simple numerical and algebraic expressions that may include two or three arithmetic operators, exponents, square roots, brackets, and one or two variables - Rearrange terms in polynomials and factor them in simple cases - Apply attributes of whole number exponents, square roots, and cube roots in simple cases - Solve first-degree equations and equations in the form of $A(x)B(x) = 0$, where $A(x)$, $B(x)$ are first-degree binomials; and $ax^2 = b$ and $ax^3 = b\ (a, b > 0)$ - Solve simple first-degree inequalities
Relationships and Functions	- Represent two directly or inversely proportional quantities with tables, graphs, or formulas, and apply the concept of proportionality - Draw a figure symmetrical to one given by applying point or line symmetry

Content Area	Objectives and Expectations
Geometry	▪ Classify angles, triangles, and quadrangles according to given attributes ▪ Apply properties of adjacent and vertical angles and parallel lines in solving simple problems ▪ Explore properties of triangles (isosceles and equilateral) and quadrilaterals (parallelograms and trapezoids), and apply the properties of congruence to triangles and symmetry to figures (point and line) ▪ Prove simple statements by using geometric properties (e.g., triangle congruence, the sum of triangle or quadrilateral angles, and the Pythagorean theorem) ▪ Draw right triangles or quadrilateral prisms, cylinders, cones, spheres, and regular pyramids and name their elements ▪ Make models of right triangles or quadrilateral prisms, regular pyramids, and other regular solid figures
Measurement	▪ Read and write results of measurements in both standard and nonstandard units ▪ Estimate parameters of simple objects in the real world, with and without measuring instruments ▪ Use formulas to calculate perimeter and area of triangles, parallelograms, trapezoids, and circles ▪ Understand and use properties of length, width, and area ▪ Apply measurement scales to solving problems that require finding length (perimeter) or area of figures ▪ Calculate the sum of the angles in triangles or quadrilaterals ▪ Calculate the volume and surface area of right prisms and cylinders ▪ Establish relationships among various units of measurement ▪ Add and subtract measurements in the same units and multiply and divide measurements in any units ▪ Calculate speed, distance, and time using relevant formulas
Statistics	▪ Find and analyze diverse statistical information from different sources ▪ Interpret and evaluate sample characteristics ▪ Display data and find numerical characteristics using spreadsheets
Probability Theory	▪ Make subsets of several elements, with elements taken from different sets or from the same set ▪ Distinguish whether order in a subset is important ▪ Use the rule of multiplication when calculating a number of subsets when the order of subset elements is important ▪ Understand the concepts underlying probability experiments and their outcomes ▪ Conduct experiments, learn how to calculate relative frequency of outcomes, and draw simple conclusions about the likelihood of each outcome

The Science Curriculum in Primary and Lower Secondary Grades

The current science curriculum in Lithuania was approved in 2008. In primary school (Grades 1 to 4), the curriculum divides integrated social and natural science into several content areas: Humans Living Together, Humans' Development, Humans' Environment, Humans' Health and Safety, Humans and Nature, and Humans and Natural Phenomena. Exhibit 3 summarizes the knowledge content and specialized skills students learn in these content areas during primary school.

Exhibit 3: Science Learning Objectives and Expectations, Grades 1 to 4

Content Area	Objectives and Expectations
Humans' Environment	• Learn about general weather changes and geographical attributes of Earth
Humans' Health and Safety	• Learn about the human body and its functions, in a simple and understandable way • Learn proper breathing, posture, vision, hearing, and hygiene • Learn first aid for oneself and others • Develop healthy diet and personal hygiene habits • Learn the causes of contagious diseases and their prevention • Learn where to go and whom to contact in an accident, and how to prevent accidents • Learn how to prevent alcohol abuse, how to calm oneself in a stressful situation, and how to rest actively
Humans and Nature	• Learn to observe and remember facts, and link them to sets of causal relationships • Pay attention to natural surroundings and the interrelationship of various life forms • Explore the interrelationship of plants and animals (based on examples of forest or pond ecosystems) • Recognize that the environment and natural phenomena (sun, air, and water) help sustain life • Recognize the importance of solar energy for life on Earth • Emphasize the consequences of human activities on nature
Humans and Natural Phenomena	• Learn to investigate natural phenomena • Using illustrations from everyday life, explore movement and its laws, the phenomenon of electricity, sources of energy and ways of saving energy, properties and changes of materials, the phenomenon of burning, and the water cycle in nature • Learn to formulate hypotheses, predict results, and draw conclusions • Learn to apply scientific methods to analyze simple problems • Develop the ability to distinguish what is true from what is probable • Learn to plan and conduct experiments, using simple instruments from everyday life as well as basic laboratory equipment

Science education in basic school (Grades 5 to 10) aims to help students acquire foundational knowledge in the natural sciences, master essential concepts and ideas in the natural sciences, acquire skills that will help them develop an understanding of the world around them, and develop certain values and attitudes. The curriculum aims to help students mature as citizens able to live healthy lives and solve sustainable development problems.

In Grades 5 and 6 of basic school, science is taught as an integrated subject, and geography is taught as a separate subject only in Grade 6. From Grade 7, biology, chemistry, and physics are taught as separate subjects.

Overall, the science curriculum focuses on knowledge and understanding, problem solving, practical skills, scientific communication, and skills for learning science. Exhibit 4 summarizes the dimensions and content areas of natural science in Grades 7 to 8 of basic school.

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Exhibit 4: Science Learning Objectives and Expectations, Grades 7–8

Dimension	Content Area	Objectives and Expectations
Scientific Investigation	Scientific Investigation	▪ Continue to learn the sequence of scientific investigation, including formulating a hypothesis based on life experience, planning and carrying out simple experiments and observations, presenting results, formulating conclusions, and identifying the main factors that influence studied phenomena ▪ Learn to predict and check relationships between two or more variables based on scientific laws ▪ Learn to research, summarize, and present information from various sources ▪ Explore the influence of the natural sciences and technology on human life ▪ Learn to apply scientific knowledge to explain phenomena ▪ Explore the issues of sustainable development, taking into account social and economic factors ▪ Investigate which personal qualities support the study of the natural sciences ▪ Learn strategies for studying science
Living Nature (Biology)	Structure and function of organisms	▪ Explore the structural and functional links of cells, tissues, and organs; photosynthesis and breathing; metabolism and energy; food and a balanced diet; the nervous system and substances that affect its functioning; and reproduction, sexual intercourse, and healthy living
	Continuity and diversity of life	▪ Explore the transmission of heritable traits, evolution, and the adaptation and classification of organisms
	Organisms and the environment: humans and the biosphere	▪ Explore the movement of substances and energy in ecosystems and populations, and the impact of environmental pollution on organisms
Matter and Change (Chemistry)	Knowledge of the composition and characteristics of matter	▪ Explore the periodic table of the elements, table periods and groups, and the composition of an atom; chemical elements and formulas; homogeneous and heterogeneous mixtures; and physical attributes of substances (e.g., mass and density)
	Changes in matter	▪ Explore physical and chemical changes in matter, signs of and necessary conditions for chemical reactions, and Avogadro's number and the mole
	Knowledge and use of common substances	▪ Explore air, oxygen, oxides, and ozone; chemical substances in everyday life; and the impact of human activities on the environment
Physical Phenomena (Physics)	Knowledge of motion and forces	▪ Explore rectilinear and curvilinear motion, distance, speed, average speed, and acceleration; the interaction of objects; inertia; mass; the relationship of force, mass, and acceleration; the forces of action and reaction; types of forces; equilibrium of bodies, center of mass, and moment of inertia; and hydrostatics and atmospheric pressure
	Knowledge of energy and physical processes	▪ Explore mechanical energy, work, power, potential and kinetic energy, and the law of conservation of energy; simple machines; molecular composition of matter (solids, liquids, and gases); thermal expansion of bodies; electrical currents and circuits; free and forced vibration; mechanical waves and sound; and light and the laws of reflection and refraction
	Knowledge of Earth and the universe	▪ Explore the phases of the moon, and the movement of the planets

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Professional Development Requirements and Programs

The 2011 Law of the Republic of Lithuania on Education stipulates that teachers should spend at least five days a year developing their competencies.[3] When a student acquires a pedagogical qualification and starts work at school, the student must first participate in a pedagogical internship.[4] The one-year internship is a suitable way to effectively develop practical academic and professional skills. Teachers are also encouraged to earn a master's degree advance their professional development.

Monitoring Student Progress in Mathematics and Science

There are no national examinations at the primary level. Students take examinations at the end of basic school (Grade 10) and at the end of secondary school (Grade 12). The examinations at the end of basic school cover the mother tongue and mathematics. Students in language minority schools take an additional examination in the Lithuanian language. At the end of secondary school, the range of final examinations (the Matura examinations, or *Brandos egzaminai*) is much wider. Lithuanian language and literature (either as a mother tongue or as the national language) is the only compulsory examination. Students are free to choose other examinations from among, biology, physics, chemistry, geography, history, mathematics, foreign languages, art, music, informatics, and mother tongue (for language minorities).

Students must pass at least two examinations to receive the secondary school leaving (Matura) certificate. Lithuania administers national sample surveys in mother tongue, mathematics, science, and social science at Grades 4, 6, and 8 that provide information at the national level about the main areas of education. Gradually, Lithuania is moving to computerized national sample survey format.

In 2014, a project was initiated to create diagnostic tools for the second grade. Since the 2013–2014 school year, all schools have been using a range of standardized tests for Grades 4, 6, and 8. Since 2015, these tests have been delivered to schools using the National Examination Centre data transmission system *KELTAS* (translated as "the ferry").[5] The tests are provided to schools free of charge. The aim of the tests is to enable schools and teachers to evaluate student learning outcomes independently and objectively and to collect feedback for improving education quality and management. At the end of the school year, standardized testing tools are stored on the National Examination Centre (now National Agency for Education) website and are available to the public.

In certain districts, students are tested to monitor school conditions and gather information for education management decisions. Example questions with scoring instructions and national level statistics are made available to teachers to help them gauge the relative achievement of their students. A number of commercial tests also are available, but they are not quality assured or standardized. Primary school students (Grades 1 to 4) do not receive grades but are evaluated in detailed narrative assessments based on teacher observations. Beginning in fifth grade, after a transitory period of approximately half a year, teachers begin grading students on a scale from 1 to 10, with 4 indicating the minimum "passing" grade and 10 an "excellent" grade.

Special Initiatives in Mathematics and Science Education

Lithuania has various initiatives for high achieving students, including The Young Researcher project, which includes the mobile laboratory MoMoLab and an accompanying biology class for learning to apply scientific methods to research and experimentation.[6,7]

There also are professional volunteer projects, whereby business professionals can share their experiences with students, national science festivals for gifted and talented students, and various subject Olympiads.[8,9]

Suggested Readings

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8   *Projektas Kam to reikia?!* ["Why do you need this?!" project]. (n.d.). Retrieved from http://www.kamtoreikia.lt/

9   Mokslo festivalis Erdvėlaivis Žemė [Science festival "Spaceship Earth"]. (n.d.). Retrieved from http://www.mokslofestivalis.eu/.