Latvia

Linda Mihno[1]
Agnese Mālere
University of Latvia

Introduction

Overview of Education System

The Latvian education system has three levels of administration: national, municipal, and institutional. The Parliament (Saeima), the Cabinet of Ministers, and the Ministry of Education and Science are the main decision-making bodies serving at the national level.

The Ministry of Education and Science is the leading State administrative institution in the fields of education, science, outer space, and sport, as well as in the fields of youth policy and official language policy. The functions of the Ministry are to develop, organize, and coordinate the implementation of policies on education, science, space, sport, youth, and official language, as well as to perform other functions specified in external regulatory enactments. In order to do so, it draws up draft sectoral legislation and policy planning documents; provides feedback on draft legislative and policy planning documents drawn up by other institutions; ensures the implementation of sectoral policy in State administrative institutions subordinate to the Ministry and State companies in which the Ministry is the holder of State capital shares; ensures the development of applications for research commissioned by the State, as well as promotes the efficient use of research results in the development and implementation of sectoral policies; cooperates with other State administrative institutions in the development and implementation of a uniform State education policy in accordance with the procedures specified in regulatory enactments; informs the public regarding the sectoral policy and activities of institutions subordinate to the Ministry; consults and cooperates with nongovernmental organizations in the decision-making process; promotes social dialogue in matters related to the development and implementation of policy; and involves representatives of the public in the State administration.[1]

Municipalities are responsible for educating the population, including providing opportunities for compulsory education and ensuring access to preschool education, secondary education, vocational guidance education, interest-related education, and adult education.[2] Municipalities must provide children living in their respective territories with access to preprimary and basic education (integrated primary and secondary education) in the educational institution closest to the child's place of residence. In addition, municipalities must also provide youth with access to secondary education and opportunities for nonformal education, as well as support extracurricular activities and camps for children.

Schools independently develop and implement educational programs, hire personnel, and manage themselves. The school principal (employed by the founder of the school) employs pedagogical and nonpedagogical personnel, manages financial resources, and ensures implementation of education laws and regulations. The head of the school may recruit assistant directors who ensure quality organization of the education process. Institutions of higher education are autonomous with regard to organizational procedures, implementation of the study process, internal procedure regulations, recruitment and dismissal of academic and technical personnel, and distribution of financing.[3]

It is mandatory for children to be enrolled in primary education from the age of 5 and to continue to acquire basic education until the age of 18. Formal education includes preprimary, basic (integrated primary and lower secondary), upper secondary, and higher education. Completion of formal education programs is confirmed by a State-recognized document on education and professional qualification. Compulsory education can also be obtained in vocational schools, schools that provide education for children with special needs, evening schools or boarding schools, social or pedagogical correction schools, or other institutions providing compulsory education programs.

The following types of education are available in Latvia:

- general education
- vocational education
- academic education[4,a]

The levels of education are as follows:

- preprimary education (corresponding to International Standard Classification of Education [ISCED] 0)
- basic education (integrated primary and lower secondary education) (ISCED 1–2)
- upper secondary education (ISCED 3–4)
- higher education (ISCED 5–7)

A student has the right to be educated at each level, moving from one level of education to the next in sequence.

Education regulations determine the standard of teaching for schools providing integrated primary and lower secondary (i.e., compulsory) education, as well as upper secondary education. The curriculum is defined in the general standard for basic education and model curricula for subjects of basic education.[5] By 2020, standards of learning were implemented, which included regulations that define the overall learning objectives and objectives for each subject, as well as descriptions of the content and timing of instruction.[6] In 2020, the regulations entered into force with a new general national standard for basic education with learning objectives and deliverables in each field of learning, as well as a timeline.[7]

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a General education is obtained in primary and secondary schools, while vocational education is obtained either in secondary schools with a vocational curriculum or in vocational training institutions or higher education institutions. Academic education is obtained in higher education institutions.

In secondary school, content is taught at three levels of learning (general, optimal, and highest) and includes national tests appropriate to each level of learning. Learning the content at the optimal level is sufficient to enter an institution of higher education. Content is taught in different categories of courses (basic, deep, or specialized);[b] each course category has a set number of hours for teaching content that the school can plan for flexibly over a long or short period of time. Each secondary school offers two course sets with at least three deep courses. The new general national standard is the same in all schools at the primary education stage, and each school can decide for itself how to implement the standard (which methods and techniques to use, etc.).

Use and Impact of TIMSS

Latvia participated in the following TIMSS cycles: TIMSS 1999, TIMSS 2003, TIMSS 2007, TIMSS 2019, and TIMSS 2023.

Several international comparative education studies have been implemented in Latvia. The results of all these studies are used to promote the quality of education in the country. Several of the reforms in the education system have taken place thanks to international comparative education studies, including TIMSS.[8,9]

The Mathematics Curriculum in Primary and Lower Secondary Grades

In Latvia, there has been a gradual shift toward a competence-based approach in learning content for basic and secondary education. Exhibit 1 summarizes the timeline when different grades began to implement the revised curriculum and standards.[10,11] Grade 4 students participating in TIMSS 2023 were taught from the new curriculum and standards starting in 2022.

Exhibit 1: Transition to Improved Educational Learning Content and Access

September 2020	September 2021	September 2022
The improved learning content and approach begins in Grades 1, 4, 7, and 10.	The improved learning content and approach begins in Grades 2, 5, 8, and 11.	The improved learning content and approach begins in Grades 3, 6, 9, and 12.

In Latvia, the Cabinet of Ministers approves educational content and issues regulations concerning what content students are required to learn at a particular age. The basic education standards divide learning content according to three grade span levels: Grades 1 to 3, Grades 4 to 6, and Grades 7 to 9.[12] The standards determine what students will know and be able to accomplish by finishing the last grade in each grade span (Grades 3, 6, and 9). Each

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b   A basic course provides knowledge, understanding, and skills at the general or optimal level of learning. A deep course provides knowledge, understanding, and skills at the highest level of learning. A specialized course provides specific knowledge, understanding, and skills at any level of learning.

schoolteacher can create his or her own program that includes the topics specified in the basic education standard; however, the country has model programs that demonstrate how specific topics could be learned in each classroom by organizing and summarizing the topics and including the skills and knowledge areas specified in the education standard. Teachers can use these model programs but can also modify or tailor them to best fit the needs of their own classrooms as an alternative to creating their own program.

For students in Grades 1 to 3, the basic education standard comprises the following topics and learning content:

- Development of Mathematical Tools (Instrument)
  - Numbers and Operations
    - four arithmetic operations with natural numbers from 1 to 100
    - numbers up to 1,000
    - comparing numbers
    - sequences of numbers
  - Geometric Figures
    - points, lines, line segments
    - polygon: triangles, quadrangles, pentagons, squares, rectangles
    - perimeter
    - right angles
    - circumference
    - rectangular parallelepipeds, cubes
- Application of Mathematics in the Analysis of Natural and Psychological Processes
  - Size and Measurements, Relationships Between Them
    - length (km, m, dm, cm, mm); mass (kg, g); time (h, min, s); volume (l); money
    - relationships between different units of measurement of the same quantity
  - Element of Information Processing, Statistics, and Transparency Theory
    - combining numbers and measures by their difference or relationship
    - reading bar charts
    - comparing objects, sorting by features
- Development and Study of Mathematical Models with Methods Characteristic to Mathematics
  - Mathematical Language
    - concepts of sum, addend, minuend, subtrahend, difference, multiplier, product, dividend, divisor, division
    - mathematical expressions, equality, inequality
    - expressing one's view and listening to other views
    - sequences of operations in mathematical expressions with and without brackets

- Development and Analysis of Mathematical Models
  - inversion, participation, presentation of group work, putting forward assumptions in projects connected with everyday situations
  - text tasks with genuine operations

According to when the new basic education standard was implemented in each grade, fourth-grade students were learning from the new basic education standard for the first time as of September 2022, while eighth-grade students were learning from the new basic education standard for the second year (from 2021). Exhibit 2 describes the topics and learning objectives for mathematics according to the syllabus based on the new basic education standard. Before the new basic education standard was implemented, students were learning knowledge and skills based on the previous basic education standard, as described in TIMSS 2019 Encyclopedia.[13]

Exhibit 2: Mathematics Topics and Learning Objectives According to the Syllabus Based on the New Basic Education Standard (as of September 2022)

Topics for Grades 1–3	Learning Objectives
How to tell and show: how much, where, what?	update and clarify what students have learned in preschool about numbers and shapes: describe what they observe, explain their actions and thoughts
How many together, how many remain?	develop an understanding of number composition necessary for addition and subtraction; gain experience using a variety of models that help to see, understand, and interpret
How to measure lengths and how to get a symmetrical figure?	begin to learn how to measure length, which can then be transferred to measuring other quantities; through practical work, develop an understanding of symmetry as a specific property of a figure
How to record and compare numbers larger than 10?	develop number sense, an understanding of the decimal system, correspondence between a given set of objects, and a written number and its verbal equivalent up to 100; learn to use different patterns and to see patterns when comparing numbers and making sequences
How to count and subtract numbers larger than 10?	learn and choose techniques for addition and subtraction up to 20 that are necessary conditions for performing these operations with any number
What does "how much more" and "how much less" mean?	relate everyday situations to corresponding mathematical activities by modeling situations with objects, drawings, writing expressions, or equations; calculate the unknown quantity
Where does one encounter big numbers?	focus on the use of numbers in everyday life, and use numbers and number operations to describe everyday situations; develop skills to add and subtract up to 100

Exhibit 2: Mathematics Topics and Learning Objectives According to the Syllabus Based on the New Basic Education Standard (as of September 2022) (Continued)

Topics for Grades 1–3	Learning Objectives
How to describe and create shapes?	learn to observe, create, and describe geometric shapes (including three-dimensional shapes) and their properties: commonalities, differences
How to group objects?	develop the ability to observe the properties of objects, to group them according to these properties, and to represent the result of the grouping
How to define different lengths?	develop the ability to take measurements in a variety of situations
How to count and subtract double digits?	develop the ability to add and subtract using problem-solving techniques and result-checking techniques that students understand and apply in a variety of contexts
How do calculations help one plan?	learn to determine the duration of an event and to read, write, and use information containing indications of time; use this information in calculations, relating the knowledge and skills acquired to practical, routine, everyday activities; plan activities
How does an expression come about?	understand that a situation in a text can be written down mathematically in different ways: in steps/actions, with multiplicative expressions, with equations, with inequations; practice analyzing and writing situations
How are shapes created and described?	reinforce understanding of the variety of shapes and the possibilities to modify them; foster creativity (when creating shapes) and ability to plan, as well as systematicity (by looking at different possible cases); develop understanding of the two quantifiers of shapes: perimeter and area
What does multiplying and dividing by 2 mean?	build understanding of multiplication and division
How are numbers multiplied and divided by 2, 3, 4, and 5?	develop understanding of multiplication, division, and comparisons; learn to memorize multiplications of single-digit numbers by 2, 3, 4, and 5
How are numbers multiplied and divided by 6, 7, 8, 9, and 10?	develop the ability to add, subtract, multiply, and divide, including calculating the value of a multiplicative numerical expression; use these skills in a variety of everyday situations, including calculating perimeter
How to use all one's actions?	develop skills in addition, subtraction, multiplication, and division, including calculating the value of a multiplicative numerical expression; use these skills in a variety of everyday situations, including calculating perimeter
How does a site plan work?	develop the ability to take measurements and use them to create a reduced image of a room (a plan)

Exhibit 2: Mathematics Topics and Learning Objectives According to the Syllabus Based on the New Basic Education Standard (as of September 2022) (Continued)

Topics for Grades 1–3	Learning Objectives
What does a part of the whole mean?	build an initial understanding of a new type of number—fraction—written as a common fraction or by using decimals
What sizes describe a figure?	develop understanding of the properties of polygons—side lengths, perimeter, area—and learn new quantities: angle (for plane figures) and volume (for three-dimensional solids)
How to count and subtract three-digit numbers?	improve numeracy skills by applying knowledge and skills of operations with numbers up to 100 to operations with numbers greater than 100
How to create 3D models?	develop geometric imagination through practical work with plane and three-dimensional shapes
Topics for Grades 4–6	**Learning Objectives**
How to count and subtract multidigit numbers?	compare, add, and subtract multidigit numbers to extract, summarize, represent, and analyze data in a variety of contexts; describe and solve everyday situations mathematically
How are multiple-digit numbers multiplied and divided by single-digit numbers?	learn to multiply and divide two- and three-digit numbers by one-digit numbers, using patterns of the decimal composition of a number, properties of operations, and the relationship between multiplication and division
How to measure an angle?	develop the ability to describe the properties of shapes by learning about the concepts of parallel and perpendicular, develop an understanding of the measurement of angles in degrees, learn to draw angles and polygons of a given size by using the magnitudes of their angles
How are multiple-digit numbers multiplied and divided by double-digit numbers?	multiply and divide multidigit numbers by two-digit numbers, relating new knowledge and skills to what is already known
How to compare, count, and subtract fractions?	deepen understanding of common fractions as numbers (fractions) by reasoning about their position on a number line; compare, add, and subtract common fractions with equal denominators; multiply a real fraction by a whole number; explain operations
What does a part of the whole mean?	deepen and broaden understanding of the concepts of "whole" and "part of a whole" to learn how to calculate the numerical value of the base, part, and whole and apply it in practical contexts
How to define the area of different figures?	deepen understanding of the concept of area to develop understanding of the use of rectangular area and the properties of area to determine the area of different shapes

Exhibit 2: Mathematics Topics and Learning Objectives According to the Syllabus Based on the New Basic Education Standard (as of September 2022) (Continued)

Topics for Grades 4–6	Learning Objectives
What does the mathematical description of shopping and movement have in common?	develop an understanding of relationships between quantities that describe movement (path, time, speed), linking and relating them to mathematical descriptions of familiar life activities (e.g., shopping)
How to write natural numbers in different ways?	systematize and deepen knowledge of natural numbers and their different forms of notation and rounding; be able to see the relationships between numbers in numerical expressions; use addition and subtraction with multidigit numbers in practical and mathematical contexts
How is dividing a number into multipliers used?	use properties of operations and the division of a number into multiples to develop numeracy and reasoning skills and to learn a new operation: powers
How to explain and use the basic properties of fractions?	develop an understanding of the basic properties of fractions and their use in comparing, adding, and subtracting fractions
How does one number express itself as part of another?	deepen and extend knowledge of the use of fractions in real and mathematical contexts; see commonalities and differences in mathematical models
How to count and subtract mixed numbers?	develop number sense, reasoning, planning, and modeling skills; learn to add and subtract mixed numbers and apply the skills learned in practical and mathematical contexts
How to determine the unknown sizes of figures?	continue to develop the ability to make/draw plane figures and describe their properties; deepen understanding of determining unknown quantities of figures by using relationships between quantities of figures, reasoning, and calculations
How to use decimals and percentages?	extend and systematize skills in working with decimals, develop an understanding of percentages and their relationship to other ways of writing fractions, learn to draw and use a pie chart
How does a visual image represent the relationship between sizes?	understand the purpose of an expression graphically drawn, learn to graph an expression and draw conclusions based on it
How is the whole divided into a specific relation?	develop and systematize an understanding of concepts related to the ratio of quantities, applying them in situations with practical and mathematical contexts
How to multiply and divide common parts?	learn to multiply and divide common fractions, mixed numbers using modeling skills, properties of operations, previously learned techniques for operations, and the basic properties of fractions; apply the skills learned in practical and mathematical contexts

Exhibit 2: Mathematics Topics and Learning Objectives According to the Syllabus Based on the New Basic Education Standard (as of September 2022) (Continued)

Topics for Grades 4–6	Learning Objectives
How does understanding comma usage help when multiplying and dividing decimal places?	learn to multiply and divide decimals using modeling, decimal composition, properties of operations, previously learned techniques for performing operations, and writing a number as a common fraction; apply the skills learned in practical and mathematical contexts
How are spatial bodies represented and characterized?	develop and systematize understanding of the representation, properties, and magnitudes of three-dimensional solids: surface area, volume, their measurement and calculation
How is interest used in domestic situations?	learn to identify one number as a percentage of another number, systematize and develop the ability to use percentages to solve practical, including authentic, problems
Why are numbers that are smaller than 0 needed?	develop an understanding of negative and positive numbers, their relationship to each other, their position on a number line and their use; explore and learn to use the whole coordinate plane
What does it mean to add a negative number to a number or subtract a negative number from a number?	model and explain addition and subtraction of a negative number, relating it to what has been learned; formulate algorithms for adding and subtracting rational numbers
How to plan to run actions with all types of numbers?	learn to multiply positive and negative numbers; develop and systematize numeracy skills with all types of numbers by planning and monitoring their activities
Topics for Grades 7–9	**Learning Objectives**
How to determine all the cells in a set and calculate the probability of an event?	systematize understanding of sets and related concepts, and the concept of probability; develop skills in representing information and reasoning
How to define geometric figures?	understand what it means to define, what it means to prove, and to systematize what students already know about geometric figures; learn how to describe mathematically the position of two straight lines in a plane
How is the relationship between variables described?	develop an understanding of the concepts of "independent variable" and "dependent variable," the notation of a relationship with a formula, deepening the understanding of directly proportional and inversely proportional quantities and their graphical representation
How to write down and study functions whose graph is a straight line?	develop an understanding of a linear function and how to represent it, improve the ability to read information from a graphical representation, and learn to make judgments about the relationship between the formula for a function and the graphical representation

Exhibit 2: Mathematics Topics and Learning Objectives According to the Syllabus Based on the New Basic Education Standard (as of September 2022) (Continued)

Topics for Grades 7–9	Learning Objectives
How to describe a triangle using its elements?	develop an understanding of the concepts related to triangles and their defining properties; develop skills in constructing plane figures and in reasoning and proving
What are the relationships between the sizes in a triangle?	develop an understanding of the concepts of property and characteristic; improve reasoning and proof skills by formulating, proving, and using relations between angles formed when two straight lines intersect with a third, and relations between sides and angles in a triangle
What does it mean to transform an expression variable?	systematize and deepen understanding of expressions with a variable, modeling their transformations geometrically and explaining them by relating them to what is already known (properties of operations)
What are the techniques for identifying the unknown?	develop an understanding of linear equations and proportions and how to solve them using different techniques, relating the new to the known, and explaining the use of graphs and equivalent transformations
How to compare expressions that contain variables?	develop an understanding of inequalities, their solution, solution techniques, and applications, improving reasoning and modeling skills
How to mathematically describe and analyze data?	learn simple statistical indicators; develop skills in data handling, display, and analysis and apply these skills in an independently planned and implemented simple study
How to explain and use whole number exponents?	extend and systematize understanding of exponent, learn and use operations with exponent in mathematics and other areas of learning
What if one can't write down a number as part?	develop an understanding of the exact value of quantities and its approximations in practical and mathematical contexts; develop an understanding of the arithmetic square root, its notation and meaning, using what is already known (properties of operations, number line)
How to calculate the area of any triangle or circle?	extend and systematize knowledge of area; use familiar area formulae and techniques to calculate area, deepening understanding
What do quadrangles with their opposite sides parallel in pairs have in common?	systematize knowledge of quadrilaterals, improve reasoning and proof skills
How to explain and perform actions on expressions?	develop understanding of and skills in using expressions with variables in mathematics, making links with what has been learned before (properties of operations and properties of powers)

Exhibit 2: Mathematics Topics and Learning Objectives According to the Syllabus Based on the New Basic Education Standard (as of September 2022) (Continued)

Topics for Grades 7–9	Learning Objectives
How to use different functions for mathematical modeling?	broaden and deepen understanding of the use of functions in mathematical modeling and develop understanding of the properties of functions and graphing
How is the length of the unknown edge of a right-angle triangle determined?	improve planning, reasoning, and proof skills by learning the Pythagorean theorem and its applications
How are similar triangles defined and described?	develop understanding of similarity of triangles and related concepts; develop reasoning and proof skills by proving similarity of triangles, investigating and formulating relationships between quantities in similar triangles; use similarity of triangles (also in practical contexts in other curricular areas)
What do quadrangles with exactly two sides parallel have in common?	systematize and extend understanding of quadrilaterals by defining the trapezium and its types; improve reasoning and proof skills by deriving the formula for the area of a trapezium, proving and using the properties of the trapezium
How can the two-edge ratio of a right-angle triangle be used in calculations?	develop an understanding of the use of the aspect ratio in calculations, and the concepts of sine, cosine, tangent, and their symbolic notation; develop planning skills and skills in using the symbolic language of mathematics
How to use splitting expressions into multiplications?	develop and systematize skills in working with algebraic expressions, deepen understanding of the advantages and importance of different ways of writing the same expression
How to explain and use formulas with a square equation or a square function?	improve algorithm formulation and reasoning skills, obtain and use quadratic equation roots formulas, and square function vertex formulas
How to describe situations with two unknown sizes?	develop an understanding of equations with two variables and their graphical representation, formulate and use algorithms to solve systems of equations, evaluate the application of the methods learned, deepen understanding of mathematical modeling of situations in everyday life and other learning contexts
How to record a string of numbers with a formula?	deepen and systematize understanding of number sequences by learning the properties of arithmetic progression, develop skills in mathematical modeling and the use of symbolic language in mathematics
How to describe the reciprocal position of a circle line and a polygon?	develop reasoning, proof, and cooperation skills, using the knowledge of geometry acquired in primary school to investigate and mathematically describe the reciprocal position of a circle line and a polygon

The Science Curriculum in Primary and Lower Secondary Grades

In Latvia, students in Grades 1 to 6 study the natural sciences as one subject. Starting in Grade 7, the subject is divided into biology and geography. In Grade 8, physics and chemistry are included as science subjects.

Up to and including Grade 3, students learn the following subjects related to natural systems and processes:

- Organism and Life Profiles—cells, tissues, parts of plants, hygiene, microorganism
  - signs of life—conduct experiments to study how plant roots function
  - plants and mushrooms—know the structure, production, and growth of plants and mushrooms; show the parts of plants in pictures and nature via experiments; identify plants using their characteristics; group plants according to forms of life; understand the adaptability of plants to various growing conditions; conduct experiments to determine the function of different parts of plants; compare different parts of plants and forms of life based on observations
  - animals—identify protected animals in pictures and nature; group animals according to their habitat; notice similarities and differences in animal behavior (in nature, at home, at the zoo, etc.); understand the adaptability of different groups of animals to a specific habitat
  - humans—know the stages of human development
- Earth and Its Place in the Universe— be introduced to the atmospheric cover of the Earth (atmosphere), mountains, rocks, and soil
- Earth in the Solar System—know separate constellations, recognize them in the sky or in models; understand the representation of Earth on a globe and a map
- Earth's Lithosphere—know the structural parts of the terrestrial globe; describe the relief of Latvia using a map; differentiate and compare rocks (gypsite, limestone, dolomite, sandstone, chalk) by particular properties (color, hardness, plasticity); understand the peculiarities of soil formation; show the highest mountain ranges of Earth on a map
- Earth's Hydrosphere—explain how water springs originate
- Earth's Atmosphere—know what atmosphere is in more detail, assess the importance of the atmosphere
- Natural Landscapes on Earth—know the geographic arrangement of natural landscapes
- Substances and Materials
  - know the concepts of mass and physical transformation
  - qualities of substances and materials—compare substances by their temperature of melting and boiling using data and the results of experiments; compare materials (rubber, caoutchouc, polyethylene, aluminum, steel, copper, etc.) by their features

based on personal observations and data; group natural materials and industrially modified materials

- the use of substances and materials—express the possibilities of using materials (glass, wood, steel, aluminum, paper, polyethylene, rubber, wool, etc.)

- Physical Processes
  - light—understand the spreading of light from different sources, observe the streamlining of light and the emergence of shadows
  - sound—know that sound is the result of vibrations (e.g., the strings of musical instruments); perform experiments with sound, changing its volume and pitch
  - heat—know about the dangers of heat, hot liquids, and other things

- Interaction of Man and Environment
  - safety—know and observe safety precautions in nature (in water, on ice, in a forest, in a swamp, in the sun, etc.)
  - environment—learn to identify protected natural objects in the nearest vicinity, acknowledge experience to care for living beings and be aware of the necessity of taking care of living beings, observe the norms of behavior in nature (e.g., protected areas), learn to safely collect mushrooms and herbs
  - health—understand personal hygiene and maintain appropriate personal hygiene, understand the importance of a healthy lifestyle and try to observe a healthy lifestyle, have a considerate attitude toward one's own health and the health of others

Exhibit 3 describes the topics and learning objectives for science according to the syllabus based on the new basic education standard.

Exhibit 3: Science Topics and Learning Objectives According to the Syllabus Based on the New Basic Education Standard (as of September 2022)

Grades 1–3	Learning Objectives
How to study living organisms?	learn to observe features and external structures of organisms (plants and animals) and to distinguish the differences between different living organisms in a safe way; explain the workings of the human body
How to study materials?	learn to experimentally determine the properties of materials: strength (paper, fabric, plastics), elasticity (rubber, linen, twine, wool, yarn), moisture resistance (different types of paper); group materials according to these properties and justify the choice of materials for a particular use in light of these properties
How to study inanimate objects?	observe and compare inanimate objects in terms of size, shape, weight, capacity, and by making and testing a hypothesis; observe how sound, heat, and light are produced and propagated

Exhibit 3: Science Topics and Learning Objectives According to the Syllabus Based on the New Basic Education Standard (as of September 2022) (Continued)

Grades 1–3	Learning Objectives
How to study natural areas?	know, distinguish, and model the natural and man-made areas in the immediate surroundings, as well as their common and distinctive features and characteristics
How to study the universe?	understand the solar system and the Moon as Earth's natural companion; represent and explain the position and movement of Earth, the Sun, and the Moon
What is the weather and how does it change?	develop the ability to make long-term observations, record what has been observed, and make predictions based on long-term observations
Why does one need energy?	raise awareness of the need for diversity of energy, the need to save energy in everyday life, and the need to follow safety rules when conducting experiments related to energy
Why is there movement?	raise awareness of the factors that determine and influence body movement and the importance of observing safety rules when moving (in transport, on the street, etc.)
What do living organisms need?	develop an understanding of living organisms, the conditions they live in, and the changes that happen to them as they grow and develop
What is common and different for different natural areas?	compare man-made and natural areas in the immediate vicinity in terms of the plants, animals, and conditions found there; conclude that living organisms have adaptations to the particular environment and place in which they live
What are the invisible fields on Earth?	develop an understanding of Earth's gravitational pull and magnetic field, the propagation of electromagnetic radiation, and the factors that influence it
How to navigate one's surroundings?	develop the ability to make a simple map of the surrounding area that can be used for orientation, locate objects on a map and on a globe
What is Earth made of?	develop an understanding of Earth's solid rock and water mantle
What substances and mixtures are around us?	identify the difference between substances and mixtures of substances, prepare and group mixtures of substances according to their characteristics, prove that air is a mixture of gaseous substances; learn how substances can undergo transformations under certain conditions (e.g., crushing, heating, cooling, compressing, mixing)

Exhibit 3: Science Topics and Learning Objectives According to the Syllabus Based on the New Basic Education Standard (as of September 2022) (Continued)

Grades 4–6	Learning Objectives
How do living organisms reproduce, grow, and develop?	develop an understanding of the reproduction, growth, and development of living organisms and the role of breeding (e.g., for fruits or animals)
How do forces work?	experimentally establish that the quantity describing the interaction between bodies is a force; illustrate the magnitude and direction of the force, and the effect of the balance of forces on the motion of bodies; establish that force can be reduced by using simple mechanisms (e.g., lever, pulley, inclined plane)
How are light and sound generated and how do they spread?	develop research skills by studying the properties of light and sound (light propagation, dispersion, reflection, refraction, sound perception, amplification, pitch, loudness)
Where is Earth in the universe?	learn about the planets and constellations in the solar system, how they are related to each other, the tides and changing seasons, and the formation of solar and lunar eclipses to expand understanding of the structure of the universe
What is the relationship between living organisms?	deepen understanding of the interrelationships between organisms in food chains, energy needs, and environmental conditions; develop an understanding of the importance of a varied diet in human life
How are materials used?	deepen understanding of materials and their properties and uses; raise awareness of the need for waste management; create their own composite material and test the material by comparing the properties of the raw material and the composite material created; produce a design product from their composite material and test how well it fits the functionality of the product
What is electricity?	through experiments and investigations, learn about electricity as a form of energy, connect simple electrical circuits, and develop proposals for the efficient and safe use of electricity at school and at home
What are natural resources and how are they used?	raise awareness of renewable and nonrenewable natural resources, how they can be used, and the need to conserve them

Exhibit 3: Science Topics and Learning Objectives According to the Syllabus Based on the New Basic Education Standard (as of September 2022) (Continued)

Grades 4–6	Learning Objectives
What natural processes happen on Earth?	develop an understanding of processes in Earth's spheres (hydrosphere, lithosphere, atmosphere) and their interactions, and develop the skills to use cartographic materials to explain natural processes and the distribution of natural phenomena on Earth
What affects the movement of objects?	further develop research skills by investigating factors affecting movement, justify the need for safety while moving (e.g., car safety in winter weather, seat belt use) using experimental and research data
How does substance transformation occur?	develop an understanding of the transformations of substances and their importance in nature, in everyday life, or in production; develop experimental skills in working with substances; develop an understanding of the process of dissolution of substances and the mass fraction of the dissolved substance
What do living organisms consist of?	develop an understanding of the subordination of the levels of organization of living organisms (cell, organ, organ system, organism), the need for organ systems (respiratory, digestive, musculoskeletal, circulatory), and the importance of physical activity in maintaining health

Starting in Grade 7, students are learning according to the new basic education standard. Before the new basic education standard was implemented, students were learning knowledge and skills based on the previous basic education standard, as described in *TIMSS 2019 Encyclopedia*.[14]

Exhibit 4: Biology, Geography, Physics, and Chemistry Topics and Learning Objectives According to the Syllabus Based on the New Basic Education Standard

Biology Topics	Learning Objectives
What is the body's core unit and how is it being studied?	deepen understanding of biological science and its fields and objects of study, and develop modeling and microscopy skills
What covers organisms?	develop an understanding of the adaptations of the human, plant, and animal body covering to their functions and living environment by modeling the structure of the skin; develop the ability to plan and carry out an experiment; develop the habit of taking appropriate action in the event of skin injuries

Exhibit 4: Biology, Geography, Physics, and Chemistry Topics and Learning Objectives According to the Syllabus Based on the New Basic Education Standard (Continued)

Biology Topics	Learning Objectives
What provides plant and animal support and movement?	develop an understanding of the structure and function of the human musculoskeletal system and the adaptability of the animal skeleton to life, study the mechanical strength of plant organs, model muscle function, develop the habit of taking appropriate action in the event of musculoskeletal injuries
How do organisms breathe?	deepen understanding of the respiratory process in different living organisms and the adaptability of animal respiratory patterns to their habitats and lifestyles, develop the habit of taking appropriate action in the event of respiratory disturbances
How do organisms feed?	deepen understanding of the structure and process of the human digestive system, the adaptability of the animal digestive system to food, plant nutrition, and the feeding relationships among organisms; carry out field research by setting up plots; develop the habit of taking appropriate action in the event of a malfunction of the digestive system
How do organisms perceive the environment?	deepen understanding of the development and preservation of the senses that are characteristics of humans (sight, hearing, smell, taste, touch); judge the adaptability of animals, plants, and protozoa to their environment; plan and carry out experiments; develop the habit of taking appropriate action in the event of sensory disturbances
How do organisms transport substances?	deepen understanding of the transport of substances in humans, animals, and plants; plan and carry out experiments; develop the habit of taking appropriate action in the event of circulatory system malfunctions
How do organisms release metabolic end products?	deepen understanding of the elimination of substances from humans, animals, and plants; plan and carry out experiments; develop the habit of taking care of one's own health by maintaining the health of the eliminatory organ system

Exhibit 4: Biology, Geography, Physics, and Chemistry Topics and Learning Objectives According to the Syllabus Based on the New Basic Education Standard (Continued)

Biology Topics	Learning Objectives
How do organisms relate to the environment they live in?	deepen understanding of the types of ecosystems, environmental adaptations of organisms in different ecosystems, relationships between organisms, conservation of species diversity through project work, and modeling; develop the habit of acting sustainably and in an environmentally friendly way, and making decisions with integrity
How does a new organism come about?	deepen understanding of the reproductive system of different organisms; develop skills in micropreparation, seed preparation, biological drawing, habits of situational awareness, and reproductive health
How does the body work properly?	develop an understanding of neural and humoral regulation, comparing the influence of the somatic and autonomic nervous systems on the body's functioning; develop the habit of acting appropriately to the situation (e.g., controlling emotions); develop the ability to identify and assess risks to maintaining nervous and endocrine health
Why are organisms so diverse?	deepen understanding of modern advances in biology, the adaptability of cells and tissues to their functions, and the role of adaptability in the diversity of organisms by comparing plant, animal, and protozoan cell structure; observing; and modeling cell structure

Teacher Professional Development Requirements and Programs

All teachers in Latvia, including mathematics and science teachers, must participate in a 36-hour professional development program over 3 years, planned in cooperation with the head of the educational institution where the teacher works.[15] The Cabinet of Ministers Regulation stipulates that a teacher can work without professional competence development as long as the teacher is studying to obtain a document certifying higher pedagogical education. After the teacher obtains a higher education qualification, he/she must attend a professional development program 3 years after receiving the document certifying higher pedagogical education.

The professional development program must include one of the following themes:

- the general competencies of the teacher
- educational content and didactics
- education management

A teacher improves professional competence in a program that is developed and implemented by a local government or private educational institution or a professional nongovernmental organization of educators. The content of the program is specified in a regulatory document for improvement of the professional competence of educators after coordination with (1) the local government in the administrative territory where it is implemented, (2) institutions subordinate to ministries or local government institutions that are not registered as an educational institution but that have bylaws that provide for the performance of educational activity, or (3) institutions of higher education that implement pedagogical study programs. Similarly, a teacher may improve professional competence in a program of at least 72 hours, after which the teacher obtains a certificate in pedagogy, special education, preschool content, and didactics; a certificate to be a career counselor of educators; or the right to implement a module of a vocational education subject that, in coordination with the Ministry of Education and Science, is developed and implemented by higher educational institutions implementing educational study programs. Teachers can also participate in a program of 160 hours, after which the teacher obtains a certificate in another subject and, in coordination with the Ministry of Education and Science, higher education institutions implementing pedagogical study programs can develop and implement. Teachers can also improve professional competence in programs developed and implemented by foreign institutions in Latvia in coordination with the Ministry of Education and Science.

Organizations that develop a professional development program must indicate the purpose, tasks, and expected results of the program; the method and structure of implementation; the target audience; the number of required hours; the planned topics; and the ways to certify completion of the program.

There is no permanent professional development program for teachers in Latvia; program offerings vary depending on supply and demand.

Monitoring Student Progress in Mathematics and Science

By 2022, the following measures were implemented in Latvia to monitor students' success: national diagnostic work in mathematics for students in Grade 3 and national diagnostic work in both mathematics and natural sciences for students in Grade 6. The key principle of diagnostic assessment is to gauge how students have achieved the standard requirements. In Grade 9, there is a centralized exam in mathematics.

From 2023 onward, national diagnostic work is not anticipated but can be carried out by a school based on a model offered by the state or by the school's own creation.

Specific Initiatives in Mathematics and Science Education

The State allocates additional funding for science, technology, engineering, and mathematics (STEM) teachers and STEM-related initiatives, including a Night of Scientists, educational programs dedicated to STEM and strengthening interest in STEM in national education centers, and a STEM teacher prep program that would allow 180 new teachers to be drafted in 3 years.

There is a State scholarship for future educators in the amount of 300 euros. The scholarship is intended to ensure the number of teachers required in State educational institutions and to promote the interest of secondary education graduates in teacher training programs, especially in priority areas of education (STEM, foreign languages [languages used in the European Economic Area (EEA)] and Latvian language, and literature).[16]

There are various activities that promote and encourage public interest in science. Examples include the event cycle Join Science!, in which the public can learn more about research carried out in Latvia in various scientific sectors, emphasizing the work of scientists and the importance of scientific achievements in the formation of the knowledge society; or *ZINĀTNE. PIETUVINĀTA* (SCIENCE. ZOOMED.IN), where students in Grades 11 and 12 talk to Latvian scientists and scientists online, revealing the exciting nature of various scientific sectors and research.

The project PuMPuRS promotes a sustainable system of cooperation between municipalities, educational institutions, teachers, support staff, and parents or representatives of students to identify students at risk of dropping out and provide them with personalized support, thus helping them to overcome their weaknesses.

A conference on scientific research activities of students develops the individual competencies and talents of students of general education institutions by deepening students' knowledge in various scientific fields, introducing students to the subjects and methods of contemporary scientific research work, involving students in direct research development, and developing students' skills to independently work in scientific research. At the national level, there are educational Olympiads, including in mathematics and science.

Suggested Reading

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