Serbia

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Introduction

Overview of Education System

Education for all under equal conditions is a principle according to the law in the Republic of Serbia. At the national level, the Ministry of Education (MoE) develops education concepts and a unified education policy; and creates laws, general regulations, and documents related to education. The Institute for Education Quality and Evaluation (IEQE) is responsible for conducting evaluation, research, and development of education, as well as standards of quality assurance. The Institute for the Improvement of Education (IIE) is responsible for teaching and learning programs, verification of textbooks, and professional development of teachers.

Preuniversity educational institutions are managed by school councils. The system of financing public educational institutions is established between the Republic and local governments.

The education system is organized as follows:

- Preschool education (International Standard Classification of Education [ISCED] Level 0) consists of nursery (for children ages 6 months to 3 years) and kindergarten (for children ages 3 to 7).
- Primary education is compulsory, spans 8 years, and is divided into two cycles. The first cycle (ISCED Level 1) comprises Grades 1 to 4, with all subjects taught by classroom teachers; however, some subjects (e.g., foreign languages) may be taught by subject teachers. The second cycle (ISCED Level 2) comprises Grades 5 to 8, with all subjects taught by subject teachers. Children enroll in first grade when they are 6½ to 7½ years old, although in exceptional cases, enrollment may be postponed for 1 year. At the end of primary school, students take a final examination. Enrollment in secondary school depends on passing the exam. Some secondary schools require students to pass an entrance examination that demonstrates extraordinary skills. Students with special education needs can attend special primary schools or regular schools.
- Secondary education (ISCED Level 3 or 4) is not compulsory and takes 3 or 4 years to complete. Types of secondary education include general secondary education (gymnasium), which takes 4 years to complete; vocational secondary education

(vocational school), which takes 3 or 4 years to complete; or artistic secondary education (e.g., art, music, or ballet schools), which takes 4 years to complete.
- Tertiary education (ISCED Levels 5 or 6) comprises basic academic and vocational studies (3 to 4 years), after which students can continue to master's academic or vocational studies or specialist studies (1 to 2 years).
- master's academic and master's vocational studies (ISCED Level 7)
- doctoral studies (ISCED Level 8)—At state universities, education is free for a specified number of students; however, doctoral studies require students to pay tuition fees.[1]

Education in the Republic of Serbia is carried out in the Serbian language. For members of ethnic minorities, it may be carried out in their mother tongue. Teaching in the languages of national minorities in primary schools has been organized in Albanian, Bosnian, Bulgarian, Hungarian, Romanian, Ruthenian, Slovak, and Croatian.

Use and Impact of TIMSS

TIMSS data have been used in Serbia in several ways, including the following:

- Education policymakers recognize the results as qualitative indicators that can influence the further development of the education system in Serbia.
- TIMSS results are used to make decisions regarding the quality of education, when defining education development strategies, and when determining expected levels of student achievement and outcomes, as well as teaching and learning programs.
- TIMSS results have a significant influence on the development process of education standards for mathematics and science.
- TIMSS data are used in teacher education programs.

The Mathematics Curriculum in Primary and Lower Secondary Grades

Teaching and learning programs are based on the general goals and outcomes of education and the needs and capabilities of students.[2,3,4,5] The programs are focused on the learning process and outcomes rather than on subject content, which now has a different function and significance. Subject content is no longer a goal in itself but instead results from achieving outcomes that are defined as the functional knowledge of the student; thus, knowing subject content demonstrates what a student has done, undertaken, and performed, thanks to the knowledge, attitudes, and skills that the student has developed over a year of studying a specific subject. Programs conceived in this way imply that the achievement of outcomes leads to the development of competencies in both general and specific subjects, as well as key competencies.

The goals of learning mathematics are for the student to master mathematical concepts, knowledge, and skills; develop the basics needed for abstract and critical thinking; develop positive attitudes toward mathematics; develop the ability to communicate in mathematical language and writing; and apply the acquired knowledge and skills in further education and to solve problems in everyday life, as well as to form the basis for further development of mathematical concepts. Exhibits 1 and 2 present expected mathematics outcomes for Grades 1 to 4 and Grades 5 to 8, respectively.

Exhibit 1: Mathematics Outcomes, Grades 1 to 4

Grade	Key Outcomes
1	• determine the mutual position of objects and beings and their position • compare objects and beings by size • observe and name geometric shapes, bodies, and figures • group objects and beings according to a common characteristic • arrange a figure consisting of known shapes • distinguish curved, straight, broken, closed, and open lines • draw a straight line and length using a ruler • count forward and backward by rule • read, write, and compare numbers up to 100; display on a number line • use ordinal numbers • distinguish even and odd numbers, largest and smallest number, preceding and subsequent number • add and subtract two single-digit numbers without writing down the procedure • add and subtract up to 100 with numbers where the total in the ones column does not exceed 10 • divide a number into additions and apply substitution • solve a simple textual task • use the terms sum, addend, diminutive, and difference • differentiate and compare currency up to 100 dinars • notice a rule and determine the next number in a started sequence • read and use data from simple bar charts and pictorial diagrams or tables • measure length with a given nonstandard unit of measure • copy points and figures in a square grid based on given instructions

Exhibit 1: Mathematics Outcomes, Grades 1 to 4 (Continued)

Grade	Key Outcomes
2	• determine the tens closest to a given number • add, subtract, multiply, and divide numbers up to 100 • use the terms factor, product, divisor, quotient, and multiple • verbally multiply and divide within the first 100 • calculate the value of a numerical expression with a maximum of two operations • solve a textual task by forming an expression with up to two operations • determine an unknown number in an equation with one arithmetic operation • determine the parts (shape) when given sizes • express an amount of money in different denominations • read and write Roman numerals • present data in a table and bar chart • notice a rule and determine the next number in a started sequence • differentiate between long, half-straight, and straight • determine the length of a line segment • determine the perimeter of a geometric figure • draw a rectangle, square, and triangle on a grid • complete a given drawing so that the resulting figure is symmetrical in relation to a given line • express length in different units • read and write time from a clock
3	• read, write, and compare numbers up to 1,000; display on a number line • perform four basic calculation operations in writing and verbally (up to 1,000) • read and write Roman numerals up to 1,000 • divide a number by another number up to 10, with and without a remainder • calculate the value of a numerical expression with up to three operations • determine the tens and hundreds closest to a given number • solve an equation with one operation • determine and write down a set of solutions to an inequality with addition and subtraction • solve a problem using a numerical expression or an equation • notice parts of a whole and write down in fraction form • compare fractions with equal denominators • write a length measurement result as a decimal number with one digit • read and use data presented tabularly or graphically (bar diagram and pictogram) • construct a triangle and a circle

Exhibit 1: Mathematics Outcomes, Grades 1 to 4 (Continued)

Grade	Key Outcomes
3	• name the elements of angles, rectangles, squares, triangles, and circles • distinguish types of angles and triangles • determine the perimeter of rectangles, squares, and triangles by applying appropriate formula • read, compare, and convert units for measuring length, volume of fluid, and time • compare sizes (length, mass, liquid volume, and time) • measure the area of a geometric figure with a given measure (rectangle, square, and triangle)
4	• write, read, and represent natural numbers on a number line • determine the place value of a digit • perform four basic calculation operations • compose an expression, calculate the value of a numerical expression, and apply properties of operations • solve equations and inequalities • solve a problem using a numerical expression, equation, or inequality • determine multiple decimal units closest to a given number • read and write fractions with a numerator and denominator less than 10 • compare fractions of a form with equal numerators or denominators • add and subtract fractions with equal denominators • write down a length measurement result as a decimal number with a maximum of two decimal places • add and subtract decimal numbers with a maximum of two decimal places • read, use, and present data in tables or graphic diagrams • name elements and describe properties of a cuboid and a cube • draw networks and make models of cuboids and cubes • recognize a pictorial representation of an appearance of the body viewed from different sides • read, compare, and convert units for measuring area and volume • calculate the area of squares and rectangles • calculate the area and volume of a cuboid and a cube • solve problem tasks in the context of measurement

Exhibit 2: Mathematics Outcomes, Grades 5 to 8

Grade	Key Outcomes
5	• calculate the value of a simple numerical expression and solve a simple linear equation inequality in natural numbers and use them to solve simple problems using numerical expression, equation, or inequality • apply divisibility rules by 2, 3, 4, 5, 9, 25, and multiples of 10 • divide a number into prime factors • determine greatest common divisor and least common multiple • perform operations on sets • analyze and describe the relations of geometric objects with mathematical notation • describe basic concepts in relation to a circle; determine the position of a point and real in relation to round • construct a parallel and perpendicular line • map a given geometric object by central symmetry and translation • use geometric accessories correctly • identify the types and describe the properties of angles • measure a given angle and draw an angle • compare, add, and subtract angles computationally and graphically • solve simple tasks using basic properties of a parallelogram (equal opposites, opposite angles) • draw a line of symmetry of a segment and an angle • determine place value • round a number and estimate the rounding error • calculate the value of a simple numerical expression, solve a simple linear equation and inequality, and solve simple problems • determine the percentage of a given size • apply ratio in simple real-world situations • calculate arithmetic mean • collect data and display them with a chart and pie chart and use a calculator or software as needed • identify an axisymmetric figure and determine its axis of symmetry • construct a line of symmetry for a segment and for an angle • collect data and show them in a table and circular diagram and use a calculator or available software as needed

Exhibit 2: Mathematics Outcomes, Grades 5 to 8 (Continued)

Grade	Key Outcomes
6	• read, write, compare, and represent numbers on a number line • determine an opposite number and absolute value of a whole number • calculate the value of a simple numerical expression, solve a simple linear equation and an inequality with a set of rational numbers, and solve a simple problem in a real context • apply proportions and percentages in real situations • display the data and the dependence between two sizes in a coordinate system (bar, dot, and line diagram) • interpret data presented in tables and graphically • classify triangles or quadrilaterals • construct 90- and 60-degree angles and use them to construct other angles • construct a triangle, parallelogram, and trapezoid • apply properties of triangles and quadrilaterals in simple problems • add and subtract vectors and use them in real-world situations • determine the center of a circle described and inscribed in a triangle • apply central and axial symmetry and translation properties in simple tasks • calculate the area of a triangle and a quadrilateral using formulas
7	• solve linear equations (including inequalities) and systems of linear equations in one or two unknowns and interpret solutions graphically • present word problems using mathematical language and solve them • identify functional dependencies and display them in different ways • understand the concept of functions and graphical representations of functions • understand linear functions and their properties • draw and interpret linear functions • interpret data presented in graphs and tables • construct a table and draw appropriate graphs and diagrams using the given data • determine the mean, median, and mode • understand the relationships between points, lines, and planes in space • understand projections in a plane and elements and properties of solid figures • calculate the surface area and volume of a solid figure • apply knowledge of solid figures in practice, linking the content of mathematics with other areas • apply elements of deductive reasoning in proofs

Exhibit 2: Mathematics Outcomes, Grades 5 to 8 (Continued)

Grade	Key Outcomes
8	• apply Thales's theorem in geometric tasks and in a real context • apply the similarity of triangles in geometric tasks and in a real context • analyze the relationships of points, lines, and planes in space and write down those relationships in mathematical letters • represent the relationships of geometric objects in a plane and space with a drawing and use them when solving tasks • observe a right triangle in space and apply the Pythagorean theorem in geometric tasks and in a real context • solve a linear equation, an inequality, and a system of linear equations with two unknowns • solve real problems using a linear equation, an inequality, or a system of linear equations with two unknowns • calculate the area and volume of a right prism and a four-sided pyramid (the base is a rectangle), and regular three-sided and six-sided pyramids • calculate the area and volume of a roller, cup, and ball • apply patterns for body surface and volume in real situations • draw and analyze a graph of a linear function • participate in the selection of a research project and way of working

The Science Curriculum in Primary and Lower Secondary Grades

In the first cycle of primary education, there are two compulsory science subjects: The World Around Us (Grades 1 and 2) and Nature and Society (Grades 3 and 4). Science education may be extended with two elective subjects in Grades 1 to 4: Hands-On Test and Nature Protectors. The goals of studying are not only to get to know oneself and the natural and social environment, but also to develop the ability to live responsibly. As mentioned, teaching and learning programs are based on general goals and outcomes rather than on merely transferring subject content. The primary purpose of outcome-based teaching is the development and mastery of knowledge as a basis on which diverse skills are developed. In that sense, teaching and learning programs offer a content framework, and teachers have the freedom to choose other content if they believe it is more appropriate for the environment in which their students live, their age and developmental characteristics, and their interests. The intent is for subject content to serve as a means of achieving outcomes, not as an end in itself. Teachers have significant freedom in choosing and connecting not only content, but also teaching methods, learning methods, and activities to guide students toward achieving a given outcome. In this way, priority is given to the contextualization of the program, the active participation of students, and teacher autonomy. In first grade, the program starts with a focus on the spatially and temporally closest phenomena for students, while in higher grades, the spatial and temporal framework gradually expands. The main focus of teaching is the development of the intellectual, psychophysical, cognitive-

conative, and social-affective spheres of the student's personality, which is reflected in the stated goal for the end of the cycle and the given subject outcomes. Subject outcomes show what students can do, undertake, and perform thanks to the knowledge, attitudes, and skills they have developed over the years.[6]

Exhibit 3 presents expected science outcomes for Grades 1 to 4.

Exhibit 3: Science Outcomes, Grades 1 to 4

Grade	Key Outcomes
1	• recognize and express emotions, respecting oneself and others • express basic life needs for food, water, and going to the toilet in a timely manner and appropriate to the situation • respect the differences of peers • cooperate with peers in joint activities • maintain personal hygiene and dress appropriately to preserve health • protect one's own, school, and others' property • follow instructions in dangerous situations: flood, earthquake, fire • describe an example of a dangerous situation in one's environment • apply the rules of safe behavior on the way from home to school when moving along the street with and without sidewalks and crossing the street • find one's way in space using spatial determinants: forward-backward, left-right, up-down • determine the time of activities using time markers: parts of the day, day and night, days of the week, before, now, after, yesterday, today, tomorrow, the day before yesterday, the day after tomorrow • determine characteristics of a material: hard-soft, transparent-opaque, rough-smooth • perform simple experiments to examine natural phenomena • distinguish nature from the products of human labor • recognize the forms of water in one's immediate environment: streams, rivers, ponds, lakes • recognize the appearance of land in one's immediate environment: plain, hill, mountain • identify plants and animals in the environment based on their external appearance • observe a variety of plants and animals based on external appearance • recognize the head, trunk, arms, and legs as parts of the body and their role • recognize the role of the senses • conserve water and dispose of waste in designated places • behave in such a way that it does not endanger plants and animals in the immediate environment

Exhibit 3: Science Outcomes, Grades 1 to 4 (Continued)

Grade	Key Outcomes
2	• identify groups of people to whom one belongs and their role • exercise rights and fulfill obligations in relation to the rules of conduct in groups • behave and respect other people's differences • accept the consequences for breaking group behavior rules • distinguish between needs and desires with simple examples • recognize the coat of arms, the flag, and the anthem of the Republic of Serbia and behave appropriately according to symbols • determine a type of settlement based on its characteristics • connect personal hygiene, staying in nature, physical activity, and diverse nutrition with health preservation • apply rules of cultural and safe behavior in traffic and means of transport according to an environment • act safely before and during weather disasters • determine material characteristics by stretching, bending, and compressing • give examples of different forms of movements in the environment • choose the way a body moves, considering the body's shape, species, and environment • measure the distance traveled by a body during its movement • find an object in a settlement using address/characteristics facilities • learn about occupations • determine the time using a clock and calendar (hour, day, week, month, year) • record and read personal data using a timeline • distinguish shapes and parts of surface water in a neighborhood and surroundings • identify common characteristics of living beings based on examples from the environment • connect body parts of living beings with their role/roles • classify plants in an environment based on leaf and tree appearance • classify animals in an environment based on lifestyle and diet • give examples that show the importance of plants and animals for humans • spend sparingly on products one uses in everyday situations • sort waste in designated places • recognize examples of the connection of living beings with conditions for life • connect changes in nature and activities of people with seasons • perform simple experiments by following instructions

Exhibit 3: Science Outcomes, Grades 1 to 4 (Continued)

Grade	Key Outcomes
3	• identify landforms and surface waters in an area • determine the position of a given object in relation to prominent forms of relief and surface waters in an area • illustrate with examples how relief and surface waters affect the life of people in a region • apply the rules of socially acceptable behavior respecting the rights, obligations, and differences between people • connect different professions and activities with the needs of people in an area where one lives • connect the types and importance of traffic in an area with people's needs • apply the rules of safe behavior in traffic • distinguish solid, liquid, and gaseous states of water in nature and everyday life • connect temperature changes with changes in volume and air movement • read water, air, and body temperature values using a thermometer • show the connections between living beings in different living communities using food chains • illustrate with examples responsible and irresponsible attitudes of humans toward the environment • apply measures to protect against infectious diseases • orient oneself in space using a compass and orient oneself in nature/ environment • describe a route that can be used to get from one point to another using a settlement plan • identify geographic objects in one's area using a geographic map of the Republic of Serbia • use time markers (year, decade, century) in everyday situations and when describing events from the past • collect and present information about the past of one's family and the region • connect the strength of an action on the body with the distance traveled • relate the falling speed of a body to its shape • distinguish between natural and artificial light sources • connect a change in the size and position of a shadow with a change in the position of a light source • relate a change in sound volume to a change in distance from its source • distinguish reversible and irreversible material changes • notice similarities and differences between liquids: flows, shape change, transparency, color, density

Exhibit 3: Science Outcomes, Grades 1 to 4 (Continued)

Grade	Key Outcomes
3	• select materials that are most suitable for use in everyday life in terms of thermal conductivity • explain how recycling helps to preserve nature • perform simple experiments and connect the result with a conclusion • cooperate with others in group activities • present results of research (written, verbal, using a timeline, PowerPoint presentation) • connect results of work with the effort invested
4	• use and read a geographic map of Serbia • connect various natural-geographic characteristics of Serbia with distribution of the population, appearance of settlements, and activities of people • respect national and cultural diversity as a basis for the coexistence of all citizens • present famous personalities, cultural assets, and natural beauty of Serbia • give preference to using local products and products made from recycled materials, as well as using renewable natural resources • connect changes in the appearance of one's body and behavior with growing up • plan daily activities and time spent with information and communications technology (ICT) devices • ask for help if faced with inappropriate content in the digital environment • identify and independently separate mixtures by sifting, casting, squeezing, and evaporating • examine electrical conductivity of materials using a simple circuit • give examples of economical use of electricity, use of magnets, prevention, and protection of fire • show significant historical events and personalities chronologically on a timeline • describe people's way of life through time using different sources of information • present a course and results of research (using a timeline, presentation, drawing) • find and select necessary information from different sources • connect results of work with the effort invested • cooperate with others in group activities

In the second cycle of primary education (Grades 5 to 8), science is taught in several compulsory subjects: biology (Grades 5 to 8), geography (Grades 5 to 8), physics (Grades 6 to 8), and chemistry (Grades 7 and 8). The elective subject Nature Protectors is also offered in Grades 5 and 6.

The biology program is designed with a spiral curriculum that is oriented toward achieving results. The basic idea of introducing a spiral curriculum is to study life and life processes based on existing conditions and the environment. To this end, all studied functions of life should be put in a realistic context and their connection emphasized. At the end of the second cycle of education, students round off their knowledge about the integrity of an organism and its dynamic relationship with the environment. The goal of studying biology is that the student, by studying biological processes and living beings interacting with the environment, develops a responsible attitude toward oneself and nature and an understanding of the importance of biological diversity and the need for sustainable development.

The goal of studying geography is for the student to master conceptually and structurally the natural-geographical, demographic, settlement, political-geographical, economic-geographical, integration, and global phenomena and processes in Serbia and the world while nurturing the values of multiculturalism and patriotism. The program is conceptualized thematically and there are essays for each topic. Although there is suggested teaching content, the teacher has full freedom to devise and create content to achieve results.

The goals of learning physics are to acquaint students with natural phenomena and the basic laws of nature, have them acquire a foundation for scientific literacy, enable them to observe and recognize physical phenomena and actively acquire knowledge about physical phenomena through research, adopt the basics of the scientific method, and direct them toward the application of physical laws in everyday life and work. The physics program is outcome oriented.

The goals of studying chemistry are for the student to develop a system of basic chemical concepts and skills for proper handling of laboratory utensils, accessories, and substances; be able to apply acquired knowledge and skills to solve problems in everyday life; and to continue education and develop abstract and critical-thinking skills, abilities for cooperation, teamwork, and a responsible attitude toward oneself, others, and the environment. The chemistry teaching and learning program is conceptualized thematically. Contents are suggested for each area/topic. The chemistry teaching and learning program is primarily oriented toward the learning process and achievement of results. Chemistry education aims to ensure that students develop basic linguistic and scientific literacy, as well as functional chemical literacy; progress toward implementing appropriate standards of education achievement; and develop the ability to solve problems in unknown situations and express their own opinions.

Teacher Professional Development Requirements and Programs

The IIE is a center for professional development of employees in education and is responsible for the continuous professional development of teachers.[7]

Every teacher employed in a school must improve professionally. Professional teacher development is monitored by the MoE and is regulated by law.[8] Within the professional development of teachers, there are two types of programs. Programs of public importance are on the minister's list and are mandatory for all teachers. Professional development programs that are on the list of programs approved by the IIE require fees.[9]

In the catalog listing professional development programs as of 2024, there are 38 programs for mathematics and the same number of programs for science. However, most of them focus on working with older students.

Monitoring Student Progress in Mathematics and Science

Monitoring student progress and assessment throughout the education system is carried out internally and externally. Internal assessments are administered by teachers, and external assessments are administered by the MoE and the IEQE.

Teachers assess student achievement using two methods: summative assessment and formative assessment. Student evaluations are descriptive in first grade. Starting in second grade, students are graded numerically based on a scale of 1 to 5.

Student achievements are assessed using both verbal and written methods throughout the year. Assessment is based on observations, student activities, verbal exams, written exams, homework, and projects. Students receive feedback on their achievements continuously throughout the school year, and they receive final grades at the end of the first semester (January/February) and at the end of the school year in June.

In Serbia, national examinations are also conducted. In cooperation with the MoE, the IEQE prepares and conducts national exams that are administered on the same date throughout the country. The final exam is administered at the end of Grade 8 (ISCED Level 2) and comprises two mandatory tests—one in mathematics and one in mother tongue—as well as one test of the student's choice—biology, physics, chemistry, history, or geography. The results of the final exam are the decisive criteria for enrollment in secondary schools.

The IEQE prepares all tests for the national exams and performs quantitative and qualitative analysis of the results. Reports are prepared for stakeholders at different levels: student, class, school, municipality, district, school management, and the entire country.

Special Initiatives in Mathematics and Science Education

At the class level, schools in Serbia organize additional classes for students who have high achievement in the field of mathematics and supplementary teaching for students with low achievement in mathematics and science.

School, municipal, and national competitions in mathematics and science are also organized. The Society of Mathematicians of Serbia is particularly active. Students can also participate in international mathematics competitions.

The IEQE presents results and participates in working groups of the IIE, which uses the results when creating professional development programs for continuing education as well as when creating teaching and learning programs.

Suggested Reading

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