

Montenegro

Marina Radović
Examination Centre of Montenegro

Introduction

Overview of Education System

The Montenegrin education system¹ is based on developing Montenegro as a society of knowledge with a focus on lifelong learning. It should facilitate an easier transition from the world of education to the world of work and better position individuals for the labor market. The Ministry of Education is responsible for the design, implementation, and development of the education system; the founding, functioning, and licensing of education institutions; and the organization of their work. The Ministry of Education is the responsible authority for education processes along with the following institutions:

- The Bureau for Educational Services defines and ensures the quality of education work at institutions and performs advisory, research, and professional tasks in primary, secondary, and preuniversity education. It is also responsible for the preparation of curricula for general education subjects.
- The Examination Centre carries out external assessments of knowledge, skills, and competencies at the completion of certain cycles of primary education. It also conducts examinations at the end of secondary education and assessments for attainment of national vocational qualifications.
- The Centre for Vocational Education is in charge of developing vocational education qualifications and curricula, advisory support, and research within the vocational education of young students and adults.
- The Bureau for Textbooks and Teaching Aids² is in charge of editing and printing textbooks and other teaching aids.

The national curricula prescribe the number of classes, outcomes for each subject, and teaching goals and provide detailed instructions for teachers. The Ministry of Education prescribes the methodology³ for quality assurance and improvement of education work at an institution (self-evaluation and evaluation). Quality assessment in an institution is conducted internally and externally. An internal quality assessment is performed by the institution itself. An external assessment is conducted every four years by the responsible public bodies.

The Montenegrin education system includes preschool, primary education, general secondary education (gymnasiums), vocational education, and higher education. The system comprises 21

public and 13 private preschool institutions; 162 public primary schools and 5 private primary schools; 51 public secondary schools (gymnasiums, vocational, and combined schools) and 3 private schools; 3 resource centers (for students with special education needs); 92 licensed adult education providers; 3 universities; and 9 autonomous private faculties.

The principal of a public institution is appointed and released by the Minister of Education. To have more transparency in the procedure of appointing a principal, the Minister forms a three-member commission to interview the candidates who meet the prescribed conditions, review the enclosed programs for the institution's development, and submit a report to the minister. A school board is the key governance body of an educational institution, along with the principal. The school board approves the annual budget for the school, school reports, school curricula, and the school's plan of evaluation.

The education system in Montenegro comprises the following levels:

- Pre-school education is organized in public or private preschool institutions in nurseries, kindergartens, or home-based centers. Nurseries are for children up to age 3, while kindergartens are for children ages 3 to 6. Preschool education is not compulsory and not a precondition for admission to primary school. Children begin learning English from the age of 3. Pre-school education in Montenegro is equally accessible to all children. Educational work in preschool education is carried out in accordance with the Law on Pre-school Education.⁴
- Primary education⁵ is compulsory and free of charge for all children aged 6 to 15 years. It lasts for nine years and is divided into three cycles. In Montenegro, primary and lower secondary education are organized as a single structure system. At the end of the third cycle of primary school, students participate in an external assessment of knowledge in Montenegrin (or Serbian, Bosnian, Croatian, or mother tongue) language and literature, mathematics, and one subject the student selects from list of compulsory subjects taught in the third cycle for at least two years. The Examination Centre prepares the tests and performs the final examination.
- General secondary education (grammar schools/gymnasium)⁶ is not compulsory and lasts for four years. Students who have completed primary education and are younger than 17 can enroll in gymnasium. At the end of gymnasium, students participate in an external assessment of their knowledge called a Matura exam.⁷ The Matura exam consists of compulsory and elective subjects. Compulsory subjects are Montenegrin (Serbian, Bosnian, Croatian, or mother tongue language and literature); mathematics or the first foreign language; and two elective subjects with graduation standards determined by the grammar school curriculum.
- Secondary vocational education⁸ is not compulsory and is implemented in a period of two, three, or four years in secondary vocational schools. Vocational education is provided by schools (theoretical part) and employers (practical part), in accordance with the education program. Students in four year vocational school take the Vocational Exam, which consists of a general part and a professional part. The Vocational Exam is taken at

the end of a three- or four-year vocational education program. The four year secondary vocational education program includes an exam in Montenegrin (or Serbian, Bosnian, Croatian, or mother tongue language and literature), an exam in a qualification-related theoretical subject, an exam in mathematics or the first foreign language, and a practical assignment with a presentation. The Vocational Exam at the end of a three-year vocational education program excludes the exam in mathematics or the first foreign language.

The Master Craftsman Exam⁹ is taken by candidates who complete three-year vocational school and have three years of work experience in the profession, as well as candidates who complete a four-year vocational school and have two years of work experience in the profession.

The Matura exam and the Vocational Exam can be external or internal. The external exam, which is a precondition for continuation of education in higher education institutions, is organized by the Examination Centre. The internal exam is organized by the school.

In Montenegro, secondary education (general or vocational) is free of charge.

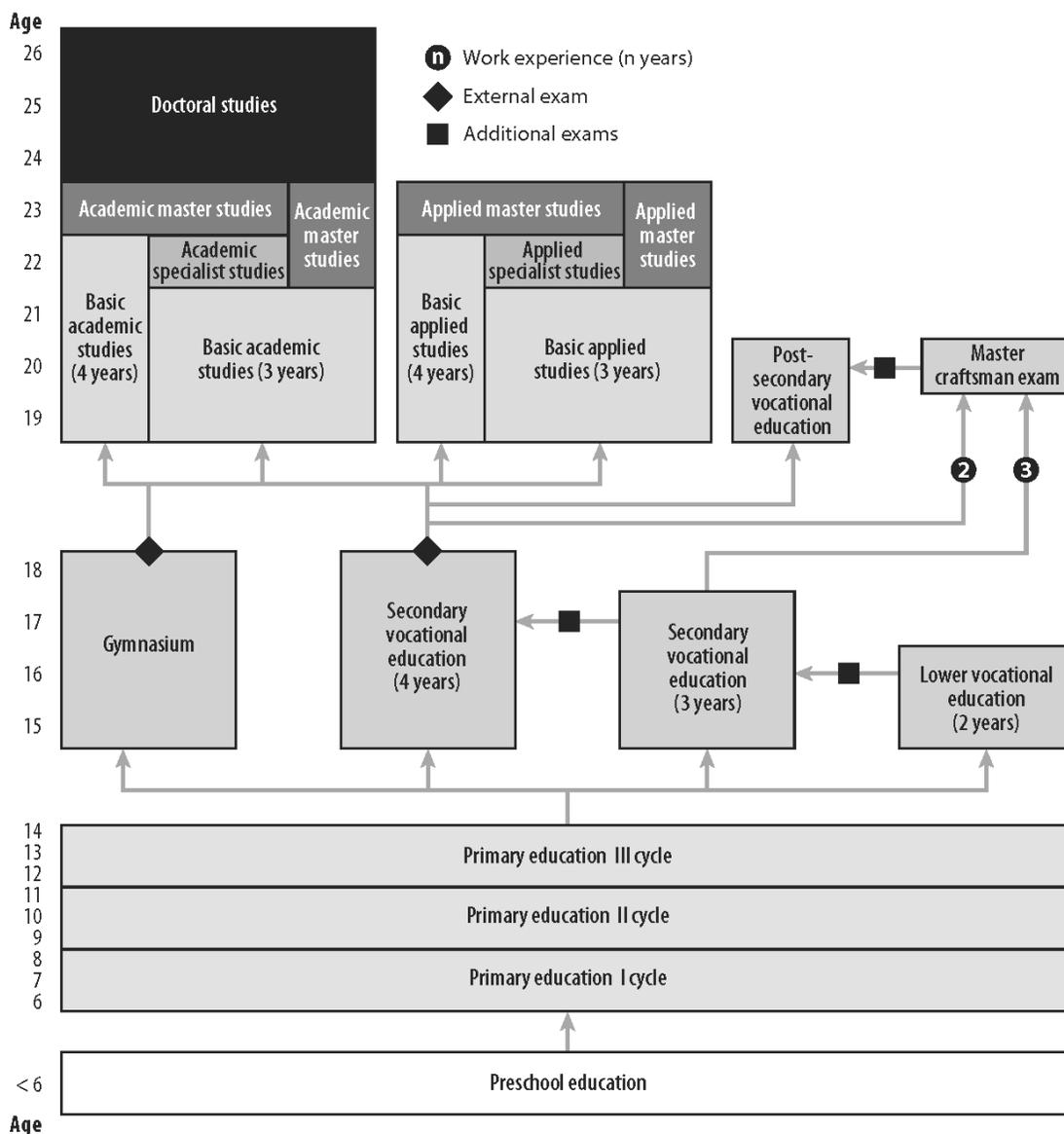
- Upper secondary nontertiary education is a continuation of vocational secondary education. It lasts for two years and ends with a diploma exam.
- Higher education tertiary education¹⁰ is acquired at the University of Montenegro, a public university, and two private universities—*Donja Gorica* University and Mediterranean University—as well as seven private faculties and two public-private faculties. The three-cycle study system includes first cycle (three or four years), graduate (specialist and master), and doctoral studies. Study programs can be academic and applied. First cycle studies last three or four years with the exception of first cycle studies in medical science, which last five or six years. Graduate specialist studies last for one year after the completion of first cycle studies, and graduate master programs last two years after completion of the first cycle. Students may continue their formal education with three years of doctoral studies that prepare them for independent scientific research.
- Adult education¹¹ is part of the unique education system of Montenegro. Adults, by their own choice, train or learn to improve their knowledge, skills, and competencies, advancing their personal and professional development. Adult education training programs in Montenegro are implemented by adult education providers licensed by the Ministry of Education. Adult education refers to various target groups (unemployed without qualifications, unemployed with qualifications that the labor market does not require, employed who want to broaden their knowledge in a specific area, and school leavers). Adult education is conducted through formal education, nonformal education, and self-directed learning. The main aim of adult education is to promote lifelong learning.

An important goal in Montenegro is to improve the education outcomes for all children. To ensure equality of opportunity and to eliminate discrimination of any kind against children, the Ministry of Education has enacted special measures to support and increase the enrollment of children from the Romany population and children with developmental difficulties. The system

offers individual developmental education programs¹² for children with special education needs (*IROP*). Children with special education needs attain their education in ordinary school classes in preschool institutions, institutions of primary and secondary general and vocational education, and resource centers. Engaging teaching assistants to provide technical support for children with special education needs is an important part of this approach.

The language of education instruction is Montenegrin. Teaching is also performed in official languages in official use: Serbian, Bosnian, Croatian, and Albanian. The Cyrillic and Latin alphabet are equal.

Exhibit 1: Scheme of education system in Montenegro¹³



Use and Impact of TIMSS

Montenegro participated in TIMSS for the first time in 2019.

The Mathematics Curriculum in Primary and Lower Secondary Grades

Learning mathematics encourages rationalization, abstract thinking, and solving problems in the student's own social environment. Above all, mathematics is a method of thinking, not a collection of formulas. Mathematics teaching is achieved through the realization and achievement of cognitive and process goals.

Through cognitive goals, mathematics knowledge forms the basis of modern general education, which enables further education. Students acquire basic knowledge of sets, algebra, geometry, combinatorics, probability, statistics, the theory of sequences, and functions; master the techniques of computation; understand mathematical rules and statements; adopt mathematical symbols; understand mathematical language; and master the techniques of mathematical modeling in solving word problems.

Through learning process goals, students develop the ability to reason logically and think mathematically; formulate and solve problems; interpret data from diagrams, tables, and charts; use geometry and measuring instruments; develop skills in computing; recognize everyday situations in which mathematical knowledge can be applied; and think innovatively, creatively, and critically. Mathematics and mathematical thinking are incorporated into all groups of subjects.

Mathematics is taught in all grades of elementary school in four class periods per week. The mathematics curriculum can also be adapted for children with special education needs. The Law on Education of Children with Special Educational Needs¹⁴ stipulates that, depending on disabilities and developmental difficulties, as well as on the individual preferences and needs of children, education programs may be shortened and adapted by changing the methodology by which the contents of the program are realized.

Exhibit 2: Mathematics Curriculum¹⁵

Grade	Concepts
1	Whole numbers; orientation in space; geometric shapes (ball, cylinder, and cube), geometric figures (circle, square, rectangle, and triangle), straight and curved lines; classifying objects by color, shape, and size; relationships (more than, less than, and equal to); cardinal numbers up to 20; addition and subtraction up to 10; zero and its role in addition and subtraction; ordinal numbers
2	Addition, subtraction, subtrahend; straight and broken lines, open and closed lines; points; cardinal numbers up to 100; adding up to 20; determination of unknown collector up to 20; units of length (meter, decimeter, centimeter); money denominations; time, simple problem solutions, elementary properties of common geometric shapes; geometric bodies (ball, cylinder, cube, square, and cone); three-dimensional shapes, including relationships with their two-dimensional representations; tables, bars, and graphs; even and odd numbers; number patterns (extending number patterns and missing terms)
3	Place value, numbers up to 1,000, multiplicands, multipliers, quotients, concepts of multiples, and factors; explaining the link between multiplication and division; odd and even number problems; comparing and drawing angles; tables and bar graphs; collecting, classifying, and displaying data and reading data from a graphical representation; listing names and describing geometric bodies and figures; units measuring length and time
4	Adding, subtracting, multiplying, and dividing numbers up to 1,000; Roman numerals; circles; multipliers, quotients, and multiples; comparing and drawing angles; tables and bar graphs; units of mass; expressions, simple equations, and relationships; fractions; solving problems involving mass, volume, and time; perimeter; parallel and perpendicular lines
5	Number sets N and N ₀ ; fractions, including comparing, ordering, adding, and subtracting simple fractions; adding and subtracting fractions with the same denominator; area; multiples; using the terms set, subset, set element, union, and section set; displaying and writing sets of corresponding symbols; comparing and drawing angles; tables and bar graphs; units of mass
6	Decimals, including place value and ordering, adding and subtracting, symmetry, percentage, units for volume measure, angles, chords, tangents, equations, proportion, operations, approximate value, and measuring angles
7	Sets of integers; computational operations in the set of integers; opposite integer numbers; the absolute value of an integer; equations in the set of integers; inequalities in the set of integers; sets of rational numbers; operations in a set of rational numbers; reciprocal numbers; double fractions; opposite number of rational number; absolute value of a rational number; equations in a set Q; inequalities in a set Q; product rule; triangles; quadrangles and quadrilaterals; parallelogram, rhombus, trapezoid, deltoid
8	Scale; proportion; squaring; the square root of a positive rational number; degree operations (product grade, degree quotient); monomials, binomials, and polynomials; binomial squares, irrational numbers; real numbers; perpendicular lines; Cartesian coordinate system; functions; equalities and inequalities; linear equation and inequality with one unknown; the Pythagorean theorem and its interpretations; application of Pythagorean theorem to squares, rectangles, isosceles and equilateral triangles, rhombuses, isosceles and rectangular trapezoids; angles of a circle; tangents; pi
9	Polygons; linear function $y = kx + b$; linear function graph; zero of a function; linear equations with two unknowns; equivalence of the system of linear equations; solving a system of two linear equations with two unknowns (the method of substitution and the method of opposite coefficients); graphical representation of solutions to the system of linear equations; examples of application of the system of equations (geometry, physics, etc.)

According to the curriculum, Grade 4 students participating in TIMSS 2019 were taught the majority of topics included in the TIMSS mathematics assessment framework. By the end of fourth grade, students have studied concepts in the following areas:

- Numbers—Whole numbers (add, subtract, and compare whole numbers), demonstrating knowledge of place values and ordering; adding, subtracting, multiplying and dividing with whole numbers; finding values on a number line; adding and subtracting using a number line; differentiating between natural and ordinal numbers; estimating and rounding two-digit numbers to the nearest 10; recognizing multiples, factors, and odd and even numbers; fractions and decimals; using words to express fractions (e.g., 10 is half of 20, one-fourth of an apple); number sentences; finding the missing number, representing problem situations; solving word problems and simple equations
- Measurement and Geometry—Solving problems involving length, including measuring and estimating; solving problems involving mass (know units for measuring liquid [deciliters and liters] and measuring mass [grams, dekagrams, and kilograms]); time; finding and estimating perimeter and area; parallel lines; drawing curved and broken lines; drawing and labeling lengths, and marking terminal points of lines; drawing horizontal and vertical lines; comparing and drawing angles; properties of common geometric shapes (circles, triangles, rectangles, and squares); recognizing and naming three-dimensional geometric shapes (cylinder, sphere, cube, and pyramid)
- Data—Collecting and interpreting data from tables, bar graphs, pictographs, line graphs, pie charts, frequency diagrams; organizing and representing data to help answer questions; drawing conclusions from data displays

The Science Curriculum in Primary and Lower Secondary Grades

In Montenegro, science in primary schools is taught in several subjects. The first and second cycles of education have two compulsory subjects^{16,17}—Nature and Society (Grades 1, 2, and 3) and Nature (Grades 4 and 5). Nature and Society explores and describes nature, the world of living and nonliving nature, ecology, and motion and orientation in space and time. Learning about the environment combines processes and topics used by students to learn about the world they live in.

In Grades 4 and 5, the Nature curriculum is coordinated with subject programs in science—biology, chemistry, physics, and geography—that are taught in Grades 6, 7, 8, and 9 of primary school. In teaching Nature, theoretical knowledge is intertwined with methods of direct observation, experimentation, and field work. This approach gives students the opportunity to actively acquire knowledge, make direct contact with life and nature, make discoveries, and better understand nature and life. The teaching of Nature should give students applicable knowledge necessary for life (e.g., knowledge of air, light, water, plants, animals and their importance to man, and the laws that govern nature) and help them develop a positive attitude toward the environment.

Exhibit 3 lists the subjects and topics in the Grade 4 science curriculum.

Exhibit 3: Grade 4 Science Curriculum

Subject	Topic	Concepts
Life Science	Physical and Behavioral Characteristics of Living Things	Differences between the living and nonliving world; physical and behavioral characteristics of living things; major body structures and their functions in humans; recognizing parts of the body and understanding that the human body is an organism; describing the main parts of plants and understanding their main functions as well as the importance of plants for life; understanding the significance of water for humans, plants, and animals; distinguishing animal species; life cycles; knowing difference between basic and extended family; becoming familiar with the life cycles of living things
	The Environment	Marking the differences among the seasons and recognizing their main features; describing the changes of seasons and linking them with changes in the lives of plants and animals
	Ecosystems	Understanding relationships in ecosystems (food chain, predator-prey relationships); understanding the correlation between people's activities and pollution; understanding man's impact on water conservation and consumption as well as the importance of protecting the air
	Human Health	Understanding the importance of personal hygiene and maintenance of health; preventing diseases; describing everyday behaviors that promote good health
Physical Science	States of Matter—Solid, Liquid, Gas	Describing physical states and properties of water by doing simple experiments; describing differences in shape and volume of each state of matter
	Classifying Materials	Classification based on physical properties, weight, mass, and states of matter; identifying observable changes in materials caused by cooling, freezing, and heating
	Common Sources of Energy	Identifying sources of energy (the sun, wind, oil, and electricity) and describing practical usage of energy
Earth Science	Earth's Surface	Describing features of the landscape and elements of the natural environment in the town or village; differences among types of soil and water (sources of fresh and salt water); noticing land and water in unequal proportions
	Earth Resources (water, oil, natural gas, soil, etc.)	Use in everyday life and recognizing the importance of using Earth resources responsibly
	Changes in Earth's surface	Changes in the Earth's surface, such as movement of water or changes in nature
	Weather and Climate	Understanding changes in nature due to climate changes (daily and seasonal)
	Earth's Motion	Understanding Earth's rotation on its axis and explaining changes in day and night and other observed patterns, such as changing seasons
	Common Sources of Energy	The sun as the source of heat and light

In the second and third cycle of primary education (Grades 6 to 9), science is taught in several compulsory subjects: biology (Grades 6, 7, 8 and 9), geography (Grades 7, 8 and 9), chemistry (Grades 7, 8 and 9), and physics (Grades 7, 8 and 9):

- Biology¹⁸ is a fundamental science that describes and explains the living world that surrounds us. Through biology classes, students are introduced to the world of living

organisms, learning about the diverse world of nature and the many dangers that increasingly threaten its survival. Through biology teaching, students should acquire basic knowledge about man as a part of nature and knowledge of environmental processes; knowledge about the structure and functions of human body systems and the immune system; an understanding of the role and importance of this science in the progress of mankind and in sustainable development; and an understanding of the structure and function of living organisms. The biology content provided by this program is essential for understanding life, nature, and the protection of the environment.

- Geography¹⁹ is a general education subject taught in Grades 7, 8, and 9 of primary school. Geography has an important role in forming a student's image of the world and understanding the phenomena and processes that govern it. Students are learning about processes in the universe, basic geographical features of all continents, and differences between nations and their cultures. Knowledge of geography is not merely knowledge of the position of a country on a map but an understanding of the laws of space; the activities of man and communities in various geographical environments; the races, religions, and languages of people in the world.
- Chemistry²⁰ is a natural and experimental science that studies substances and their structures, characteristics, and changes. Students acquire chemical literacy—i.e., the basic knowledge, skills, and attitudes that enable them to actively and responsibly engage and function in contemporary society. The teaching of chemistry is based on an experimental-research approach through problem solving. It contributes to an understanding of nature and society and helps students develop a positive attitude toward chemistry and science.
- Physics²¹ teaching in primary school develops students' ability to recognize physical phenomena in their everyday life and understand simple physical concepts that generalize their knowledge of nature. Students learn that physics describes phenomena at all sizes, from the smallest particles to larger universe. Students are introduced to important achievements and technical and technological processes that would not have been possible without physical knowledge. Through active learning and experimental work, students acquire new knowledge and appropriate ideas about cause and effect relationships between natural phenomena.

Professional Development Requirements and Programs

In Montenegro, educational activities at educational institutions are conducted by preschool teachers, teachers and professional associates. Preschool teachers have completed a three-year study program Level 6 qualification (180 ECTS) or Level 7, sublevel one, qualification (240 ECTS). In the first cycle of primary education, instruction is carried out by classroom teachers who have completed a relevant program Level 7, sublevel one, qualification (240 ECTS), while in the third cycle instruction is carried out by subject teachers with Level 7, sublevel one or sublevel two, qualification (240 ECTS or 300 ECTS). Subject teachers in both primary and secondary educational institutions have an increasing number of roles in teaching. They are required to have pedagogical,

psychological and didactic knowledge to connect the different roles and achieve the planned goals of teaching and learning.

Professional development of teachers is a long-term process and enables teachers to acquire and expand their knowledge through learning, practical work and research activities. Professional development enables teachers to develop skills and abilities that are relevant for the success of both curricular and extracurricular activities of students. Teachers select the programs they wish to attend from a list of programs approved by the Bureau for Education Services and Centre for Vocational Education. Teachers are issued a license²² for working in educational institutions after passing the vocational exam. The license is issued for a period of five years.

Teachers renew their license every five years by completing 16 hours of professional development in a priority training area as well as 8 hours in non-priority training area.²³ Teachers who did not take exams from the pedagogical-psychological and didactic-methodological groups of subjects during their studies will need to undergo 16 hours of professional development in these fields. In addition to regular professional development there is an additional training program for the principals of education institutions. The general goal of the program is to train school principals for a successful management of an educational institution. The training program requires 96 hours of work at seminars and 80 hours of work at home (such as project assignments and professional work), for a total of 176 hours. After completing the training program, principals have to produce professionally written work with both theoretical and practical application to a problem faced by the institution that they manage.

To provide continuous support and improvement opportunities for teachers, a system of teachers' professional development has been established. The system is based on the General Law on Education and is supported by the rulebook.²⁴ The General Law on Education stipulates that the state budget finance professional development training hours.

The system of professional ranks has been established as a motivating factor to support teachers who are improving their knowledge and skills through professional development and practically applying their knowledge in the teaching process. It offers teachers the opportunity to progress to one of the following ranks: teacher mentor, teacher adviser, teacher senior adviser, or teacher researcher.

Teachers, principals or assistant principals who do not have a license or did not renew their license cannot work at an educational institution.

Monitoring Student Progress in Mathematics and Science

Knowledge assessment and evaluation make it possible to monitor students' individual development and enhance their motivation for further work and improvement. The short tests after each area covered can be used to monitor progress and test knowledge. They must be clear, closely related to the goals, and based on the types of tasks and methods practiced in class. Assessment should be based on defined standards of knowledge. Students are encouraged to recognize the usefulness of newly acquired knowledge in everyday life.

In addition to the usual oral and written examinations, the following methods should also be used: students' work monitoring, class activity, debates, practical papers, students' reports, presentations, etc.

The Examination Centre prepares examinations to monitor students' achievement relative to the minimum standards defined by the curriculum. At the end of Grade 9, students are required to take an external national exam.²⁵ Exam results play an important role in secondary school enrollment.

According to school policy and the curriculum for each subject and Law on Primary education,²⁶ the assessment of students' knowledge is carried out by teachers and is expressed by marks. The marks reflect students' achieved standard of knowledge. A student receives a final report card at the end of each grade. After completing the Matura/vocational exam, students receive a diploma.

In the first cycle of primary school, student evaluations are descriptive. In the second and third cycle assessment, results are expressed using a system of numerical marks: (1) failed/insufficient, (2) sufficient, (3) good, (4) very good, and (5) excellent.

According to the Law on Primary Education, students in lower grades (Grades 1 to 4) are automatically promoted. Students with a maximum three insufficient marks at the end of the school year have to take a makeup exam in order to complete the grade. Students with more than three insufficient marks at the end of the school year cannot complete the grade. A student may repeat the same grade once. During the school year, to avoid retention, schools offer regular remedial lessons in each subject (including mathematics and science subjects) for students who need additional instruction and individual attention.

Special Initiatives in Mathematics and Science Education

According to the curriculum for primary schools, one of the special initiatives for students from first to eighth grade is School in Nature. Therefore, one of the important objectives of the school should be to develop students' competencies through teaching that encourages them to explore, discover, analyze, and understand the world around them. Students learn through experience, by understanding concepts in their immediate reality, observing natural changes, and analyzing cause and effect relationships. The education goals of the School in Nature are improving the quality of students' knowledge, adopting practical skills for life, developing a responsible attitude toward the environment, and having a positive attitude toward a healthy lifestyle.

Mathematics and science are important, compulsory curricular subjects in primary school. Mathematics and science learning is promoted in the lower grades through popular school competitions. Very popular among students in upper grades are competitions that are offered for all science subjects and mathematics. Students who place first, second, or third in a national or international competition can apply for an award for talented students. According to the Ministry of Education's Rulebook on Criteria, Manner, and Procedure of Allocation of Funds for the

Improvement of Teaching Quality and Talents,²⁷ talented students who apply for an award should achieve outstanding results in a particular teaching subject or area, or high achievement overall.

In addition to adapting the program to children with special education needs (gifted children or children with disabilities), according to the Law on Primary Education,²⁸ the school is obligated to organize additional classes during the school year for students who master the content with great success and show a special interest in expanding and deepening knowledge in certain teaching areas, as well as students for who are behind in mastering the teaching material.

The 21st Century School project²⁹ is a technology initiative implemented in all primary schools. All schools in Montenegro receive “micro:bit” computers that serve as a basis for developing programming skills. The initiative focuses on early development of digital competencies. Using a micro:bit computer, gifted students³⁰ can solve everyday problems in various school subjects. The device enables students to learn in a fun, interactive, and innovative way.

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