Montenegro

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Introduction

Overview of Education System

The Montenegrin education system is based on developing Montenegro as a society of knowledge with a focus on lifelong learning.[1] It should facilitate a smooth transition from the world of education to the world of work and a better position for an individual in the labor market. The Ministry of Education is responsible for the design and development of the education system, as well as the founding, functioning, licensing, and organizing of the work of educational institutions. For the purpose of education policy implementation and quality assurance, the government has established the National Council for Education and the Council for Qualifications.

In addition to the Ministry of Education, the following institutions have various responsibilities in the education process:

- The Bureau for Educational Services plays a key role in defining and ensuring the quality of educational activities in institutions. It undertakes advisory, research, and professional tasks related to primary and secondary education, as well as preuniversity education. Additionally, the bureau is responsible for developing curricula for general education subjects.
- The Examination Centre is responsible for conducting external assessments to evaluate the standards of knowledge, skills, and competencies achieved at the conclusion of specific stages of primary education. Additionally, it administers international research studies, as well as examinations at the end of 4-year secondary education, and assesses the attainment of national vocational qualifications.
- The Centre for Vocational Education is tasked with developing qualifications and curricula for vocational education. It provides advisory support and conducts research in the field of vocational education for both young students and adults.
- The Bureau for Textbooks and Teaching Aids is responsible for the editing and printing of textbooks and other teaching materials used in preuniversity education.

The national curricula prescribe the number of classes, outcomes for each subject, and teaching goals, and provide detailed instructions for teachers. The methodology for quality assurance and improvement of education work at an institution (self-evaluation and evaluation) is prescribed by the Ministry of Education.[2] Quality assessment in the institution is done

internally and externally. Internal quality assessment is performed by the institution itself. External assessment is done every 4 years by the responsible public bodies.

The Montenegrin education system includes preschool, primary, general secondary (gymnasiums), secondary vocational, and higher education. The system comprises 21 public, 31 private, and 5 international private preschool institutions; 163 public and 6 private primary schools; 51 public secondary schools (gymnasiums, vocational, and combined schools) and 5 private secondary schools; 3 resource centers (for education of children with special education needs); 123 licensed adult education providers; 4 universities; and 5 autonomous faculties.

The Agency for Control and Quality Assurance of Higher Education oversees quality assurance activities in higher education, aligning them with the European Standards and Guidelines.

The principal of a public institution is appointed and released by the Minister of Education. The school board, along with the principal, is the key governance body of an educational institution. The school board approves the annual budget (financial plan), reports, curricula, and plan of evaluation for the school.

Preschool education/kindergarten is primarily delivered in preschool institutions, which can be either public or private.[3] These institutions provide early childhood education and care for children before they enter primary school. Preschool education plays a crucial role in a child's development by providing a stimulating and nurturing environment where children can learn through play, socialize with peers, and develop essential skills that form the foundation for later learning. Both public and private preschools in Montenegro aim to prepare children for primary education and help them acquire the necessary skills and knowledge for their future academic success. Preschool education is for children up to 3 years of age; nurseries and kindergarten are for children ages 3 to 6 and are divided into groups according to age. Preschool education, which involves children up to the start of primary school, is not compulsory and is not a precondition for admission to primary school.

Primary education is compulsory and free of charge for all children ages 6 to 15.[4] It lasts for 9 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, there is an external assessment of students' knowledge in Montenegrin, Serbian, Bosnian, Croatian, or mother tongue language and literature; mathematics; and one subject selected by students from a list of compulsory subjects that are taught in the third cycle for at least 2 years. The Examination Centre prepares tests and performs the final examination.

In Montenegro, secondary education (general or vocational) is free of charge. General secondary education is not compulsory and lasts 4 years.[5] General secondary education is delivered in grammar schools and mixed secondary schools. Students who have completed primary education and are younger than 17 can enroll in grammar school. At the end of grammar school, there is an external assessment of students' knowledge called the Matura exam.[6] The Matura exam consists of compulsory and elective subjects. Compulsory subjects are Montenegrin, Serbian, Bosnian, Croatian, or mother tongue language and literature; and

mathematics or the first foreign language. Two elective subjects (subjects with graduation standards determined by the grammar school curriculum) are assessed on the Matura exam. The education in grammar schools prepares students for higher education, including university studies. Students in grammar schools focus on a broad range of subjects, including mathematics, sciences, languages, and social sciences.

Mixed secondary schools offer a more diverse curriculum that combines general education with vocational training. These schools provide education in various fields such as economics, technical studies, arts, and social sciences. Mixed secondary schools are designed to prepare students for both further education and the job market, providing students with practical skills alongside academic knowledge.

Secondary vocational education is not compulsory and can last 2, 3, or 4 years in secondary vocational schools.[7] The theoretical part of vocational education is provided by schools, and the practical part is provided by the employer in accordance with the educational program. A vocational exam is taken at the end of 3- or 4-year vocational education programs. Students in a 4-year vocational education program take a vocational exam that consists of two parts: general and professional. The exam includes an exam in Montenegrin, 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 supporting presentation. The vocational exam at the end of a 3-year vocational education program is the same but does not include the exam in mathematics or the first foreign language.

The master craftsman exam is taken by candidates who complete 3-year vocational school and have 3 years of work experience in the profession, or by candidates who complete 4-year vocational school and have 2 years of work experience in the profession.[8]

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

Upper secondary nontertiary education typically lasts 1 or 2 years. This level of education serves as a bridge between compulsory education and higher education. During this period, students may receive additional academic or vocational training, preparing them for further studies at the tertiary level or for specific careers in the workforce.

Higher education (tertiary education) is acquired at the University of Montenegro (a public university), at a state independent faculty, or at private universities and faculties.[9] As of academic year 2017–2018, all first-year students in public institutions in Montenegro have been exempt from paying tuition fees. This exemption also applies to students enrolled in the first year of master's studies at public institutions during academic year 2020–2021. The three-cycle study system includes first cycle (3 or 4 years), graduate (specialist and master's), and doctoral studies. Study programs can be academic and applied. First-cycle studies last 3 or 4 years, with the exception of first-cycle studies in medical science, which last 5 or 6 years. Graduate specialist studies last for 1 year after completion of first-cycle studies (3+1), and

graduate master's studies last 2 years after completion of first-cycle studies. Students may continue their formal education with doctoral studies for 3 years, which prepare students for independent scientific research.

Adult education is part of the unique education system of Montenegro.[10] Adults, by their own choice, train or learn to improve their knowledge, skills, and competencies, raising the level of personal and professional development. Adult education training programs in Montenegro are implemented by licensed adult education providers. A license for work is issued by the Ministry of Education. Adult education refers to different target groups (e.g., unemployed without qualification or with qualification who are not required in the labor market anymore, 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 of the education system is to improve the educational outcomes for all children. The government provides support to students by offering scholarships. Scholarships are awarded to talented students, top performers, those pursuing specific qualifications, and individuals from Roma and Egyptian communities. International partners contribute through collaboration and mobility programs.

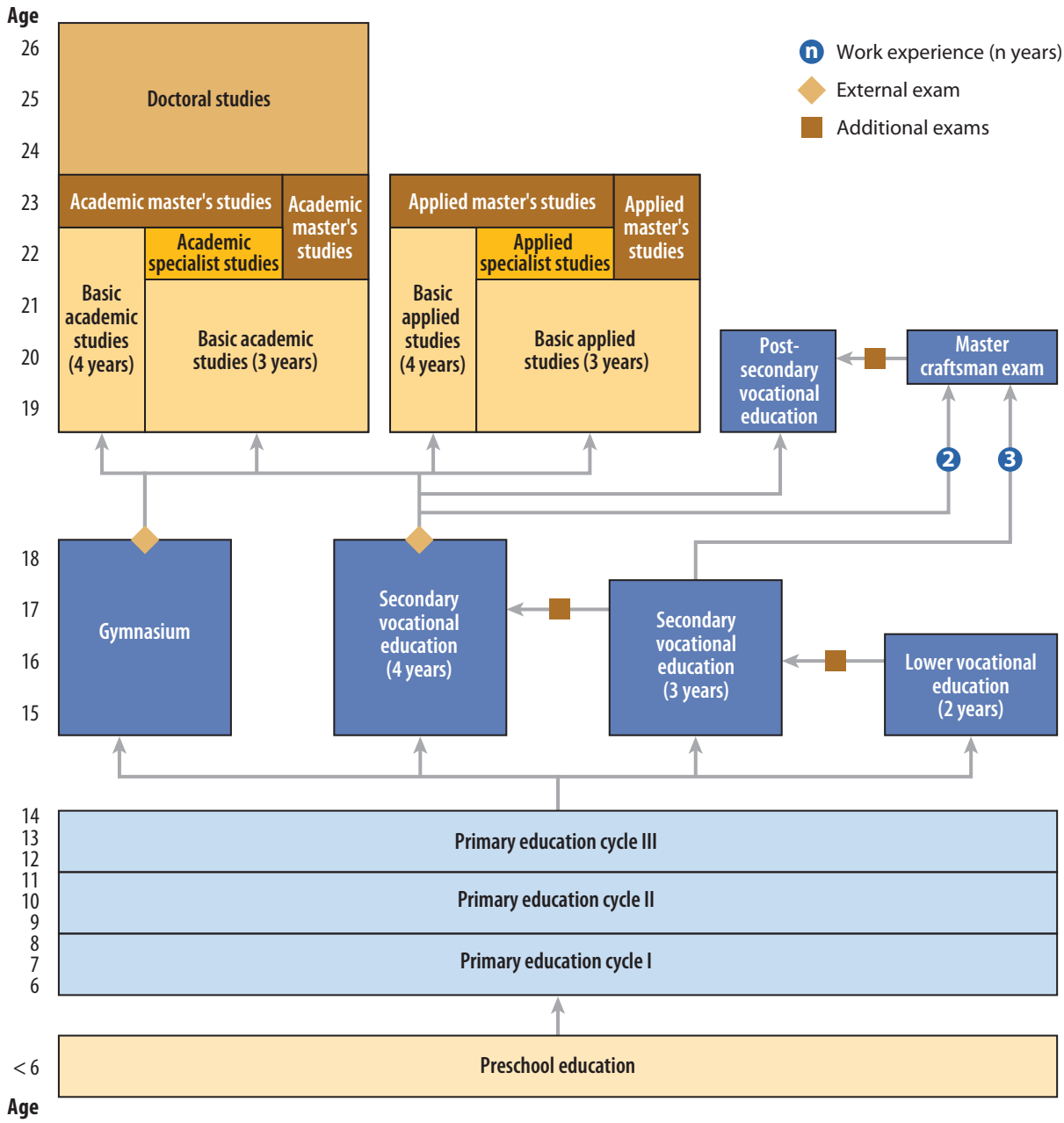
To promote equal opportunities for and eliminate discrimination against children from Roma and Egyptian communities, the Ministry of Education has implemented special measures in Montenegro and inclusion programs for these children across all levels of education. Over the years, there has been a continual increase in the enrollment of Roma and Egyptian children in primary and secondary education. To support secondary school students, the Ministry of Education collaborates with the Ministry of Labour and Social Welfare to provide free textbooks, and the Ministry for Human and Minority Rights offers scholarships. An individual developmental education program (IROP) is for children with special education needs. Children with special education needs attain their education in ordinary school classes in the preschool institution, institutions of primary and secondary general and vocational education, and in resource centers.

The government has established a reward fund to recognize outstanding achievements from the previous school year with annual awards. Additionally, the Ministry organizes the "Oktoih" State Award competition, honoring exceptional contributions to education and student life. Three awards are presented each year to individuals or entities in Montenegro for outstanding accomplishments in these fields.

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

Exhibit 1 presents the education system in Montenegro.

Exhibit 1: Scheme of Education System in Montenegro[11]



Use and Impact of TIMSS

This is the second cycle of TIMSS in Montenegro. Like many countries, Montenegro participates in TIMSS to assess its education system and gather valuable data on student performance in mathematics and science. The following describe some ways that TIMSS is used and its impact in Montenegro:

- TIMSS provides Montenegro with a standardized way to assess the performance of its students in mathematics and science. By participating in TIMSS, Montenegro can compare the achievement levels of its students with those in other countries,

which helps identify strengths and weaknesses in its education system. This allows stakeholders to identify areas that may need improvement in terms of curriculum, teaching methods, or resources.

- TIMSS data inform education policies and reforms. Montenegro's education authorities can use the findings to make decisions about curriculum development, teacher training, and resource allocation to improve student performance in mathematics and science.
- Participation in TIMSS provides Montenegro with international recognition and validation of its education system. It allows the country to showcase its commitment to improving educational outcomes and aligning with global education standards.
- TIMSS data can raise awareness of Montenegrin students' low results in mathematics and science.
- TIMSS data can make clear the necessity of organizing teacher trainings and numerous science, technology, engineering, and mathematics (STEM) seminars and workshops for teachers of lower grades of primary education.

In summary, Montenegro uses TIMSS as a valuable tool to assess and improve its education system in mathematics and science, identifying areas for improvement and ultimately working toward providing high-quality education for all students.

The Mathematics Curriculum in Primary and Lower Secondary Grades

Learning mathematics encourages rational thinking, abstract thinking, and the ability to solve problems within a student's social context. Above all, mathematics is a method of thinking rather than a collection of formulas. Mathematics teaching occurs through the realization and achievement of cognitive and process goals. Through cognitive goals, students should adopt mathematical knowledge that forms the basis of modern general education important for further education; acquire basic knowledge of sets, algebra, geometry, combinatorics, probability, statistics, theory of sequences, and functions; master the technique of computation; understand mathematical rules and statements; adopt mathematical symbols; understand mathematical language; and master the techniques of mathematical modeling in solving textual tasks.

Through learning progress goals, students should develop the ability to use logical reasoning, conclusion, and mathematical thinking; skills and abilities to formulate and solve problems; skills of interpreting data presented by diagrams, tables, or charts of different types; skills in using geometric accessories and measuring instruments; skills in computing; the ability to recognize situations in everyday life in which mathematical knowledge can be applied; innovation and creative thinking; critical-thinking skills; and ethical, cultural, and work habits, criteria, and abilities.

Mathematics and mathematical thinking are incorporated into all groups of subjects. Mathematics is taught in all grades of primary school in four classes per week.

The mathematics curriculum can also be adapted for children with special education needs. The Law on Education of Children with Special Education Needs stipulates that, depending on disabilities and developmental difficulties, as well as on children's individual preferences and needs, educational programs may be shortened and adapted by changing the methodology by which the contents of the program are realized.[12]

Fourth-Grade Mathematics Curriculum[13]

Grade 4 students are taught the following mathematical content and terms: numbers up to 1,000; adding, subtracting, multiplying, and dividing; Roman numerals; circle, multiplier, quotient; concepts of multiples; comparing and drawing angles; tables, bar graphs; units for mass; expressions, simple equations, and relationships; fractions; solving problems involving mass, volume, and time; perimeter, parallel, and perpendicular lines.

According to the curriculum, Grade 4 students participating in TIMSS 2023 were taught the majority of topics that were included in the TIMSS mathematics assessment framework. By the end of fourth grade, students should be able to do the following:

- number—understand the concept of whole numbers (add, subtract, and compare whole numbers), demonstrate knowledge of place values and ordering; add, subtract, multiply, and divide with whole numbers; find values on a number line; add and subtract using a number line; differentiate between natural and ordinal numbers; estimate and round two-digit numbers to the nearest 10; recognize multiples and factors, and odd and even numbers; understand fractions and use words to express fractions (e.g., 10 is half of 20, one fourth of an apple); use number sentences to find the missing number, representing problem situations; solve word problems and simple equations
- measurement and geometry—solve problems involving length, including measuring and estimating; solve problems involving mass (know units for measuring liquid [deciliter and liter] and units for measuring mass [gram, dekagram, and kilogram]) and time; distinguish between angles, a square, a rectangle, and a triangle, and be able to draw and mark them and calculate their perimeter; distinguish between a circle and a circular line, and know how to draw a circular line and list the elements of a circle
- data—collect and classify data from tables, display collected and classified data tabularly and using columns, read data from a table and from a graph

The Science Curriculum in Primary and Lower Secondary Grades

In Montenegro, science is taught in several subjects in primary school. In the first and second cycle of primary education, there are two compulsory subjects: Nature and Society (Grades 1 to 3) and Nature (Grades 4 and 5).[14,15] The subject Nature and Society explores and describes nature, the world of living and nonliving nature, ecology, 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 the subject programs in the science group of subjects—biology, chemistry, physics, and geography—in Grades 6 to 9 in primary school. In teaching the Nature curriculum, theoretical knowledge is intertwined with methods of direct observation, experiments, and fieldwork. This gives students the opportunity to actively acquire knowledge, interact directly with life and nature, and make certain discoveries through their own research, enabling them to 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, the laws that govern nature) and shape their positive attitude toward the environment.

By the end of fourth grade, students should acquire knowledge on and be able to do the following:

- life science (physical and behavioral characteristics of living things)—differentiate between the living and the nonliving world; differentiate between physical and behavioral characteristics of living things, including the following:
  - major body structures and their functions in humans—recognize parts of the body and understand that the human body is an organism; describe the main parts of plants and understand their main functions, as well as the importance of plants for life; understand the significance of water for humans, plants, and animals; distinguish animal species
  - life cycles—know the difference between members of the basic and extended family to become familiar with the life cycles of living things; interact with the environment by differentiating among the seasons and recognizing their main features, and describing the changes of seasons and connecting them with the changes in the lives of plants/animals; understand relationships in ecosystems (food chain, predator/prey relationships); understand the correlation between people's activities and pollution; understand man's impact on water conservation and consumption; understand the importance of protecting the air
  - human health—understand the importance of personal hygiene, maintaining health, and preventing diseases; describe everyday behavior that promotes good health
- physical science
  - states of matter (solid, liquid, gas)—describe physical states and properties of water by doing simple experiments; describe characteristic differences in the shape and volume of each state of matter
  - classify materials based on physical properties, weight/mass, and state of matter; identify observable changes in materials caused by cooling, freezing, and heating; identify sources of energy (e.g., the Sun, wind, oil, electricity) and describe practical uses of energy
- earth science
  - Earth's surface—describe features of Earth's landscape and elements of the natural environment in a town or village; differentiate among types of soil/water (sources of fresh and salt water); notice land and water in unequal proportions

- Earth's resources (water, oil, natural gas, soil, etc.)—identify resources used in everyday life and recognize the importance of using those resources responsibly
- changes in Earth's surface—describe changes that happened on Earth's surface, such as movement of water or changes in nature
- weather and climate—understand changes in nature due to climate changes (daily/seasonal changes)
- Earth's motion—understand Earth's rotation on its axis and explain the change from day to night and other observed patterns, such as the change in seasons
- common sources of energy—identify the Sun as the source of heat and light

Teacher Professional Development Requirements and Programs

Teachers organize and carry out educational activities and work on their own development.[16] Preschool instruction is carried out by preschool teachers. A preschool teacher can be a person who has completed a 3-year study program for preschool education. In the first and second cycle of primary education, instruction is carried out by classroom teachers who have finished the program at the Faculty for Teacher Training. In fourth and fifth grades, instruction is carried out by classroom teachers, while subject teachers carry out instruction of foreign language, basics of technology, physical education, fine arts, and music culture. In the third cycle of primary education, instruction is carried out by subject teachers. In primary school, mathematics, physics, biology, and chemistry are taught by teachers who graduated from the respective course of study within a 4-year study program, which is obligatory to have a license for work.[17]

Professional development of teachers allows them to acquire, expand, and deepen the knowledge, 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 Educational Services. Teachers are issued a license after passing the professional exam for working in educational institutions.[18] The license is renewed every 5 years if teachers have completed 16 hours of professional development programs in a priority training area and 8 hours in other teacher training programs.[19] Teachers who did not take pedagogical, psychological, and didactic subjects during their own studies need to complete 16 additional professional development hours in those fields.

In order to provide continuous support and improvement opportunities for teachers, a system of teacher professional development has been established. The system is based on the General Law on Education and is supported by the *Rulebook on the Types of Titles, Conditions, Method, and Procedure of Proposing and Awarding Titles*.[20]

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. Teachers have the opportunity to progress to one of the following four ranks: teacher mentor, teacher adviser, teacher senior adviser, and teacher researcher.

The responsibility for continuous professional development of teachers lies mainly with educational institutions involved in the development of education, such as the Bureau for Educational Services and the Centre for Vocational Education, as well as the educational institutions themselves. This process is governed by the General Law on Education, secondary legislation, and documents approved by the National Council for Education.

Teacher professional development takes place through various methods, including individual, formal, and informal approaches. The *Rulebook on the Organization of Teacher Professional Development and the Manner of Selecting Authors of Professional Development Programs* provides specific guidelines for organizing the professional development of teachers, preschool teachers, professional associates, teaching associates, and other educators, as well as the process for choosing authors of professional development programs.[21]

Continuous professional development encompasses a range of activities, such as participating in professional development programs; utilizing professional literature and other resources; conducting exemplary and demonstration lessons or activities; engaging in observation and feedback; taking part in events such as focus groups, roundtables, panel discussions, poster presentations, and debates; conducting action research; joining professional networks at different levels; and attending national and international conferences and academic gatherings.

Ongoing Professional Development Programs

Ongoing professional development programs in Montenegro include the following:

- assessment in mathematics
- assessment in the function of encouraging development of mathematical literacy
- assessment techniques in primary school mathematics classes for written tests of knowledge
- electronic tests in the teaching process
- function and properties of good knowledge tests
- tests that fit students
- digital classroom—the door to the future
- I get to know the nature around me through an experiment
- functional integrated learning
- I play and create
- the use of active learning methods in classroom teaching
- active learning methods in teaching natural sciences: student clubs
- creative additional teaching of mathematics in the younger grades of primary school
- mathematical literacy
- planning and realizing relevant outcomes through examples of environmental protection and reducing the impact on climate change
- creative possibilities of developing initial mathematical concepts

- methods of educational work for getting to know the environment in preschool education
- GeoGebra in class
- formation of students' environmental literacy

It is important to note that all classroom teachers are obligated to integrate cross-curricular topics through the regular teaching/learning process. These topics include content that is not part of a formal discipline or an individual subject. These topics are interdisciplinary in structure, covering areas such as entrepreneurial learning, education for sustainable development, and education in the field of emergencies caused by natural disasters. These topics significantly improve the competencies of students from the standard group of subjects.

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. Short tests after each area covered can be used to monitor progress and test knowledge. They must be clear, closely related to the goals set, 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 standard oral and written examinations, the following should also be used as methods of assessment: monitoring student work, class activity, debates, practical papers, student 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 the third cycle of primary education, an external assessment of students' knowledge of Montenegrin or mother tongue, mathematics, and one subject selected by the student from the list of compulsory subjects, which are taught in the third cycle in at least two grades, is carried out. Exam results are very important for secondary school enrollment.

During the classification period, all students, except for those in first grade, are assessed and graded in each subject. According to school policy, the curriculum for each subject, and the Law on the Primary Education System, teachers assess students' knowledge through oral questioning, written tests, and various student presentations, practical works, and seminars.[22]

The school is required to provide written notification to parents at the conclusion of each classification period detailing the student's success, achievements, and progress. The evaluation encompasses grades in subjects, behavior, and overall performance. However, for first-grade students, this comprehensive assessment occurs only at the end of their initial classification period.

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 the Primary Education System, students in lower grades (Grades 1 to 4) do not fail the grade, and it is very rare that students cannot reach minimal standards of knowledge. Students in the third cycle (Grades 7 to 9) who receive a failing mark in one, two, or three subjects must take a final makeup examination in June and August. Students who have failing marks in four or more subjects must repeat the grade. During the school year, in order to avoid retention, schools offer regular remedial lessons in each subject (including mathematics and science subjects) for students who need additional instruction, as well as individual help for slow learners.

Special Initiatives in Mathematics and Science Education

According to the curriculum for primary school, one special initiative for students in Grades 1 to 8 is called School in Nature. Therefore, one of the important tasks of the school should be to develop students' competencies through teaching that will encourage them to explore, understand, discover, and analyze the world around them. Students learn through experience, by understanding life and teaching content in their immediate reality, observing natural changes and analyzing cause-and-effect relationships. The educational goals of the School in Nature initiative are improving the quality of students' knowledge, learning practical skills for life, developing a responsible attitude toward the environment, and having a positive attitude toward a healthy lifestyle.

Mathematics and science are very important compulsory curricular subjects in primary school. One method of promoting the learning of mathematics and science in each of the lower grades is through popular school competitions. Very popular among students in upper grades are competitions that are offered for all science and mathematics subjects. Students who win first, second, or third place in a national or international competition can apply for the award for talented students. According to the *Rulebook on the Criteria, Manner, and Procedure for Allocation of Funds for Improving Teaching Quality and Talents*, students who apply for the award should achieve remarkable results in specific teaching subjects or areas, or at least very good overall success.[23]

Teachers in the first cycle of primary education implement cross-curricular topics through the teaching of mathematics, such as the use of information and communications technology (ICT) and entrepreneurial learning. This fosters the development of initiative, persistence, and using creative approaches to problem-solving. Students up to the age of 10 develop these competencies through extracurricular activities that are an integral part of the primary school curriculum.

In addition to adapting lessons for children with special education needs (gifted children or children with disabilities), according to the Law on the Primary Education System, schools are obligated to organize additional classes during the school year for students who with great success master the content and show a special interest in expanding and deepening knowledge in certain teaching areas, as well as for students who are behind in mastering the teaching material.[24]

The project Mathematics +, organized by the Association of Mathematics Teachers of Montenegro, has been implemented in some primary schools. Students can attend 10 free advanced mathematics workshops, lasting 90 minutes. The association also provides free *Diagonal* magazines for all workshop attendees. Extremely practical, concise, and written so that all the basics can be understood, *Diagonal* is noteworthy because it is the only math magazine intended for learning the basics in Montenegro. Since 2018, it is published every quarter and has been available in bookstores and school libraries, and it covers the school curriculum from Grades 6 to 9 with units that clearly separate material intended for different ages.

The implementation of the international Eco-School program contributes to improving the quality of teaching and learning in the field of education for sustainable development; encourages students and young people to actively participate in and care for their environment; challenges students to get involved in solving environmental problems at a level where they can see tangible results; and develops a sense of responsibility in them, both in everyday life and in school life. The Eco-School program has been implemented in 95 educational institutions.[25]

Suggested Reading

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