# Macao SAR

*The Education and Youth Development Bureau (DSEDJ)*

## Introduction

### Overview of Education System

The Education and Youth Development Bureau (*Direcção dos Serviços de Educação e de Desenvolvimento da Juventude*, hereinafter referred to as DSEDJ) is the government department responsible for developing, directing, coordinating, administering, and evaluating tertiary and nontertiary education in Macao Special Administrative Region (SAR). It is also responsible for a range of societal organizations involving young people and for supporting youth associations and similar organizations.[1] The education landscape it manages encompasses both nontertiary and tertiary education segments.

Nontertiary education comprises two components: formal education and continuing education. There are three stages of formal education: infant education (3 years; starts at age 3), primary education (6 years; starts at age 6), and secondary education (3 years junior secondary plus 3 years senior secondary; starts at age 12). The maximum age of students at the primary, junior secondary, and senior secondary education levels is 15, 18, and 21, respectively. Vocational and technical education is only available at the senior secondary level, whereas special education runs throughout infant, primary, and secondary education levels for students ages 3 to 21. One key characteristic of Macao's nontertiary education is that it is obligatory, a form of compulsory education for all students ages 5 to 15. Students ranging from 3 to 18 years of age can benefit from 15 years of free education in both public and private schools. Tuition subsidies are also available for students attending private schools that do not offer free education.

Continuing education refers to the various educational activities that are outside the realm of formal education. It comprises family education, recurrent education, community education, and courses on vocational training. Of note is that there is no recurrent education set up at the infant education level, whereas at the primary and secondary education levels, the education structure is the same as that of formal education. A comparison of the study plans between formal and recurrent education reveals that the courses offered for recurrent education are more flexible and dynamic, and they are more tailored to the characteristics of the learners. Moreover, recurrent education students can complete their study year-by-year progressively, as well as by accumulating credits earned because of their course enrollment.

Per Article 122 of the Basic Law of Macao SAR, all educational institutions are entitled to exercise their autonomy, teaching, and academic freedom.[2] They are also permitted to hire staff and utilize teaching materials from beyond Macao SAR. Whether in public or private schools,

teachers can adopt mathematics or science curricula and associated learning resources that are school based or imported from abroad.

To steer the development of education in Macao, the DSEDJ introduced the *Curriculum Framework for Formal Education of the Local Education System*, *Requirements of Basic Academic Attainments*, and Curriculum Guides between 2014 and 2017.[3]

The *Curriculum Framework for Formal Education of the Local Education System* (hereinafter referred to as the Curriculum Framework) serves as a guide for schools, helping them optimize their curriculum structures and systematically plan educational activities. This ensures that formal education in Macao maintains a high level of quality and diversity, fostering the holistic development of students.

The *Requirements of Basic Academic Attainments* (hereinafter referred to as BAA) outline the fundamental proficiencies students should acquire after completing various education stages. These include essential knowledge; skills; and the cultivation of emotional, attitudinal, and value-based development. BAA for primary schools were introduced during the 2016–2017 academic year for primary 1–3 and were extended to all primary grades in the 2017–2018 academic year. For secondary schools, BAA were initiated during the 2017–2018 academic year for junior secondary 1 and senior secondary 1 and were then progressively implemented in subsequent years, encompassing higher grade levels.

The Curriculum Guides offer in-depth insights into the historical progression of curricula for specific disciplines at distinct education levels (e.g., primary mathematics). They provide a list of content topics, offer instruction suggestions with illustrative examples, propose assessment methods, present exemplary lesson plans, and facilitate school-based implementation. BAA and Curriculum Guides encompass all subject areas and curricula from kindergarten to secondary schools. Schools should follow these curriculum frameworks and standards.

Macao's tertiary education is provided by 10 educational institutions, of which four are public and six are private. In addition, overseas institutions are also granted permission to offer tertiary programs jointly with local universities or after-work continuing education centers. The programs offered include doctorate, master's, and bachelor's degree programs; postgraduate certificate programs; and higher diploma programs.

## Use and Impact of TIMSS

In 2023, Macao participated in TIMSS for the first time. Upon the completion of the internationally organized report, the DSEDJ will conduct a thorough analysis of the TIMSS results. This analysis will involve a comprehensive examination of students' levels of mathematical and scientific literacy, as well as a study of the various factors influencing student performance in these subjects.

In addition, the DSEDJ will explore strategies for enhancing the teaching of mathematics and science, drawing insights from experiences in various regions. These insights will inform the refinement of Macao's education policies, planning, and classroom practices.

To ensure that the evidence gathered from mathematics and science assessments contributes to curriculum and teaching improvements, the DSEDJ will continue its efforts to provide teacher education in these specific areas. These initiatives aim to boost the professional capacity of educators and enhance their effectiveness in teaching mathematics and science.

## The Mathematics Curriculum in Primary and Lower Secondary Grades

As mentioned, the DSEDJ released six curricular documents for mathematics education in Macao: BAA and Curriculum Guides for mathematics at the primary, junior secondary, and senior secondary levels.

In a nutshell, these documents stipulate the basic proficiencies in knowledge, skills, abilities, attitudes, and values in mathematics upon the completion of education at the primary, junior secondary, and senior secondary levels. They spell out the minimum standards instead of the "ceilings," which allows schools to develop their own curricula based on their education visions, missions, and students' abilities.[4]

By law, schools should follow BAA to ensure that all students reach the basic proficiencies. However, different schools might use different mathematics textbooks, which might bring about different teaching practices in schools.[5]

The objectives of BAA for primary school mathematics, which are applicable to Macao's primary 4 students, are as follows:[a]

- enable students to know basic mathematical knowledge, understand the relationship between mathematics and students' daily life and social development, and become aware of the importance of mathematics
- develop students' basic mathematical skills, including correctly using simple drawing and measuring tools, drawing basic geometric figures, and making statistical charts
- develop students' mathematical abilities, including calculation, spatial imagination, data processing, logical reasoning, etc., and have students be able to apply mathematical knowledge to solve simple application problems in their daily life
- nurture students' interest and self-confidence in mathematics learning, and their understanding of the importance of mathematics
- develop students' skills to use mathematical language to communicate and discuss with others

a For more information about BAA in primary mathematics and secondary mathematics, see https://www.dsedj.gov.mo/crdc/edu/BAA_primary/despsasc-19-2016-anexo_vii_eng.pdf and https://www.dsedj.gov.mo/crdc/edu/BAA_junior/despsasc-56-2017-anexo_vii_eng.pdf

The content areas of primary school mathematics include the following:

- Numbers and Arithmetic—introduces students to the base-10 place value number system and the meaning and application of four operations of whole, decimal, and fractional numbers, focusing on developing basic computational skills
- Shapes and Space—provides students with basic geometric concepts, including lines, angles, planar figures such as triangles, rectangles, etc., and spatial figures and their measures (length, angle, perimeter, area, volume); the relative positions of objects; and three views of an object to describe the real world around them
- Quantity and Measurement—helps students understand different attributes of an object and appropriate measurement tools; the units of length, weight, area, time, volume and capacity, angle, etc.; and how to use them to represent quantities in life
- Statistics and Probability—helps students learn how to do statistics through collecting, sorting, and analyzing data from a variety of situations; representing data using appropriate statistical figures such as bar graphs, pie charts, etc., and statistical concepts (e.g., mean); and developing an understanding of certainty and uncertainty of the occurrence of events
- Basic Knowledge of Algebra—provides students with basic concepts in algebra such as using letters to represent numbers, building equations to represent equality in simple circumstances and solving them, and understanding direct and inverse proportions

The objectives of BAA for junior secondary mathematics, which are applicable to Macao's junior secondary 2 students, are as follows:

- enable students to acquire important mathematics knowledge, basic mathematics thoughts, and essential application skills that are necessary for the students' social lives, practical activities, and continuous study of mathematics or mathematics-related disciplines
- cultivate students' abilities in mathematical reasoning, calculation, spatial imagination, and problem-solving, as well as the abilities of cooperation, exchange, and independent thinking
- develop students' awareness of and ability to flexibly apply mathematical thinking to judge problems through participating in mathematical activities such as observation, practice, thinking, exploration, exchanges, etc.
- nurture students to recognize the value of mathematics, develop good study habits and scientific attitudes, and experience the fun of mathematical activities and the advantages of using mathematical thinking and methods in solving certain problems
- allow students to experience success in imaginative and creative activities, temper their willpower to overcome adversities, and become confident and creative learners

The secondary level mathematics content areas include the following:

- Numbers and Algebra—introduces students to the extension of number systems and operations on rational and real numbers, algebraic expressions and their values, equations/inequalities and their solutions, and functions and their properties
- Shapes and Space—helps students develop imaginary skills through the learning of basic geometric concepts including points, lines, and angles; basic shapes like triangles, quadrilaterals, and circles; and the relationships among them and solid figures
- Statistics and Probability—introduces students to the basic ideas about population and sampling, data collection, analysis (using histogram, three average concepts to represent the center of a set of data, and variances), and interpretation; the basic understanding of probability of random events; the probability of classic models through experiments; and the use of tables and tree diagrams

## The Science Curriculum in Primary and Lower Secondary Grades

Just as for mathematics, the DSEDJ introduced the Curriculum Framework, BAA, and Curriculum Guides for science at the primary, junior secondary, and senior secondary levels while retaining the diversity of educational approaches.

The objectives of BAA for primary science applicable to Macao's primary 4 students are as follows:

- enable students to learn basic knowledge of health and hygiene, as well as form habits for living a healthy life
- help students develop an accurate understanding of sex and learn to protect themselves and respect others
- enable students to understand the tradition and status quo of the community and foster the spirit of caring for and serving society
- enable students to understand the historical traditions and social culture of Macao and China and respect cultural differences
- teach students to care for the social development of Macao, China, and the world; develop their ability to think about and criticize social issues
- nurture students' curiosity about and interest in the natural environment and the world of science; develop their inquisitive and innovative mind
- enable students to learn about natural and scientific knowledge related to life and progressively master the ability to put knowledge into practice and problem-solving skills
- enable students to care for the environmental issues faced by human beings and help them develop the habit of preserving resources and protecting the environment

- enable students to pay attention to the development of science and technology, and understand its influence on human life, social economy, and the natural environment
- preliminarily cultivate students' ability to obtain, organize, and analyze information

The primary education science content covers the following four main areas:

- Healthy Life—introduces students to foundational concepts related to health and well-being with a focus on developing basic health literacy and promoting a healthy lifestyle
- Culture, Society, and Life—provides students with a foundational understanding of Macao, the territory of China, and the world around them with a focus on Macao as a special region under the influence of eastern and western cultures
- Natural Environment and Life—designed to introduce students to the natural world and foster an understanding of the environment, ecosystems, and the interconnectedness of life on Earth
- Science and Life—introduces students to fundamental scientific concepts, covering topics such as light, sound, heat, magnetism, electricity, mechanical principles, and technology

The secondary education science content, as outlined in BAA, covers the following four main areas: Scientific Inquiry, Physical Science, Life Science, and The Earth and Space Science. Macao has not participated in TIMSS at the junior secondary 2 (Grade 8) level.

## Teacher Professional Development Requirements and Programs

Optimization of the teaching staff team is included as one of nine key measures to achieve Macao's development objectives for nontertiary education in 2021–2030. In particular, Macao intends to (a) explore new forms of education and train teachers to have sufficient ability to deal with education development, including new educational technologies and skills, new classroom models, new integrated subjects, philosophical and logical subjects, and career planning; (b) optimize existing contents and models of teacher training based on their needs; (c) promote teaching and research mechanisms such as building teaching and research teams, providing necessary resources and staff for research projects, and modifying teaching models; (d) pay attention to the professional development of teachers working in private and public schools; and (e) create a social atmosphere of respect for teachers and their teachings, care about their physical and mental health, etc.[6]

### Professional Development Requirements

Teaching staff working in nontertiary education private schools are ranked according to a system of six levels, and promotion is made based on their service time, work performance, evaluation, and professional development. They are explicitly required to complete a certain number of professional development hours. For example, to be promoted from Level 6 to Level 5, a teacher

is required to complete at least 90 hours of professional development activities during the 3 years of service at Level 6.[7]

Teachers, at their convenience, can choose areas or topics that suit their developmental needs. Among the areas included are: (1) teaching knowledge and literacy, including education ethics, subject knowledge, curriculum and assessment, teaching strategies, teaching research, and classroom management; (2) student growth and counseling, including education and development psychology, teacher-student relationships, moral education, counseling, and guidance; (3) education administration and management, including education policy, school administrative management, and partnership; and (4) social and personal development, including community relations, relations with professional organizations, and other professional knowledge related to education.

## Ongoing Professional Development Programs

The DSEDJ continuously provides a wide range of professional development activities for Macao's mathematics teachers in the areas listed above. In particular, these activities include courses, lectures, seminars, workshops, and learning exchange events. Such training activities enable teaching staff to continuously grow, update, and improve their professional quality. Meanwhile, a platform is provided for Macao teaching staff to share and collaborate on their experiences. Training activities particularly targeted at mathematics teachers include the following: Using Applications to Create Tools for Teaching Vectors, Mathematical Games, Interesting Activities for Geometric Constructions, workshops on improving student learning strategies, instructional design, mathematics and programming, and interdisciplinary theme learning in mathematics. Mathematics teachers can register, attend, and accumulate professional development hours at their convenience.

The DSEDJ provides a range of professional development courses for Macao's science teachers in the areas mentioned above. In addition, a program focusing on integrated science, technology, engineering, and mathematics (STEM) teaching is provided to primary science teachers.[8] Science teachers are requested to learn how to design an inquiry pedagogical method based on the 5E Model of Instruction (Engage, Explore, Explain, Elaborate, and Evaluate) in their teaching of integrated STEM learning and formative assessments that measure not only academic attainment in science content through tests, but also 21st-century skills such as complex problem-solving and creativity skills through the evaluation of prototypes, authentic performance, and process-oriented assessments. Furthermore, with the aim of promoting the advancement of science education in Macao, the DSEDJ, in collaboration with the Macao Science Center (MSC), provides primary science teachers with a range of training programs such as the Primary School Science Promotion Teacher Training Program. This partnership aims to bolster science teachers' capabilities, enabling them to enhance science education and facilitate their students' learning of scientific concepts. In addition to the programs provided by the DSEDJ and the MSC, teachers are free to participate in international and local conferences that suit their developmental needs.

## Monitoring Student Progress in Mathematics and Science

The Student Assessment System for Formal Education of Local Education System[9] has been implemented since the 2021–2022 academic year. It promotes diversified assessments, which means establishing adequate content, forms, and participants of assessment based on the learning objectives defined for each level and type of education and the respective requirements of BAAs, in particular: (1) The contents of assessment shall include students' cognition, affection,[b] and skills; (2) The forms of assessment shall include the use of oral assessment, performance assessment, portfolio assessment, written assessment, and electronic assessment; and (3) In addition to teaching staff, assessment shall also involve the participation of parents and students.

Assessments through monitoring students' progress in the attainment of intended learning outcomes in science and mathematics are common practice in Macao classrooms.[10] For mathematics education, teachers use diversified assessments to collect information about students' performance so as to make appropriate evaluations and interpretations. They also make an effort to understand students' difficulties in their mathematics learning through discussion, asking and answering questions with students or having students discuss among themselves. These discussion opportunities allow students to express themselves. For science education, it is also indispensable to adopt diversified assessment models to reflect on students' performance in learning science. For instance, teachers use scientific investigation, practical work, scientific research, and other methods to assess students' performance. Through these practical assessments, teachers get to know students' performance as well as their development of science knowledge, practical skills, and attitudes. Such assessment methods can also foster students' critical-thinking skills, creativity, and problem-solving skills. In addition to classwork, homework, tests, and examinations, project-based learning is also commonly used as an assessment activity.

The Macao SAR government has been encouraging schools to take part in international large-scale education surveys. Since 2003, Macao has participated in the Programme for International Student Assessment (PISA) organized by the Organisation for Economic Co-operation and Development (OECD). PISA is a worldwide large-scale assessment held every 3 years to evaluate the reading, mathematics, and science literacy of 15-year-old students. Macao has participated in seven sessions so far (2003, 2006, 2009, 2012, 2015, 2018, and 2022).

In addition, Macao also participated in the 2016 and 2021 cycles of PIRLS organized by the International Association for the Evaluation of Educational Achievement (IEA).

By participating in these international education surveys, Macao is able to obtain more objective scientific reference data and valuable information that may help the DSEDJ formulate targeted education policies. In addition, in-depth internal evaluation by schools and evaluation by external entities can also effectively monitor student learning progress. The integrated evaluation of schools organized by the DSEDJ involves a panel of internal staff and external

b Affection is a term that refers to emotion, attitudes, and values (e.g., curiosity, interest and confidence in learning activities, developing good learning strategies and habits).

reviewers who review school documentation and conduct class observation to provide schools with comments for improvement and development to ensure education quality.

## Special Initiatives in Mathematics and Science Education

Macao has several initiatives that focus on mathematics and science education. Seven noteworthy examples include the following:

- The Education Fund was founded in 2022 by merging the Student Welfare Fund, the Education Development Fund, and the Higher Education Fund.[11] It aims to support the education system and education development policies of the Macao government by providing subsidies and incentives for various programs and activities that help to ensure and enhance the quality of education and students' comprehensive ability and competitiveness, as well as by providing grants and benefits to students. In academic year 2023–2024, the following funding plans have been implemented based on application: school development funding plan, tuition subsidy, meal subsidy and school supplies subsidy, full-time staff funding plan, funding for scientific research and smart education, students' talent development plan, and application skills development plan.
- Co-organized by the DSEDJ and the MSC, the Student Science and Technology Education Popularization Plan (2022–2023 academic year) was initiated to support schools to participate in science popularization day activities held at the MSC. It aims to enhance students' hands-on and inquiry abilities, and cultivate their scientific literacy through a variety of scientific activities in science and technology offered by the resources at the MSC.
- With the goal of identifying talent in the field of science and technology at an early age, the Program for the Development of Scientific Innovation Talent of Youth Science and Technology Village was initiated to provide specialized training for secondary students. The program was launched in September 2023. Its annual target is to recruit 100 secondary school students whose school recommends them as having expertise in the field of science and technology. Qualified students are provided a training program of 3 years. The program is also committed to promoting the development of vocational and technical education, cooperation between schools and enterprises, and youth career planning support.
- In order to enhance primary school students' curiosity and observation abilities to encourage them to do hands-on activities and to enjoy the fun of seeking knowledge while learning, the DSEDJ has organized hands-on activities for primary school students annually since the 2002–2003 academic year. These activities provide students with opportunities to do research projects in different fields such as society, culture, nature, and physics; write reports; and make presentations to share their

work, as well as their reflections on the processes. Multiple competencies of primary students can be developed through these processes.

- The DSEDJ has organized a variety of competitions around mathematics, mathematics-related subjects, and mathematics education for students from primary school to preuniversity levels. The Macao Association of Mathematics Education Research also has brought students to the American Regions Mathematics League (ARML) since 2009. Macao schools regularly send their students to attend international mathematics competitions. The goals of these initiatives are to provide students with opportunities to learn more about mathematics beyond BAA; to allow them to apply their knowledge and skills to solve real-world problems; to foster their interest in mathematics; and to ultimately encourage students to pursue careers in mathematics, science, and technology.
- Since the implementation of integrated STEM education in classrooms, schools have been actively encouraged to engage in STEM competitions on both local and global scales, with financial support provided by the DSEDJ. The primary objectives are to offer students opportunities to apply their knowledge and skills in real-world scenarios, nurture creativity and innovation, and broaden their horizons by collaborating with their counterparts.
- The DSEDJ introduced integrated STEM (iSTEM) education to local schools in mid-2020. Alongside the professional development program that focuses on pedagogical approaches and classroom assessment, teachers receive a comprehensive set of resources to enhance their iSTEM lessons through a project called Curriculum and Instruction Resources for iSTEM Classrooms. Furthermore, students are offered a range of after-school iSTEM activities, such as the Innovation and Inquiry: Integrated STEM Experiential Camp. These activities are designed to foster their inquiry skills while engaging with cross-disciplinary STEM subjects.

## Suggested Reading

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