Israel

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Introduction

Overview of Education System

The education system in Israel is relatively centralized under the supervision of the Ministry of Education, which determines the national curricula, including a compulsory core curriculum, and implements national and international educational testing policies. The K–12 education system consists of three levels: preprimary education (ages 3 to 6); primary (elementary) education (kindergarten to Grade 6 for students ages 6 to 12); and secondary education, comprising lower secondary education (Grades 7 to 9 for students ages 12 to 15) and upper secondary (senior high) education (Grades 10 to 12 for students ages 15 to 18).[1] Although most primary schools offer six years of education (for students ages 6 to 12), approximately 25 percent of primary schools offer eight years of education. Education is compulsory for students ages 3 to 18, but this requirement is being implemented gradually and currently is fully implemented only for ages 5 to 16.

Almost all schools in the education system are public. Schools are generally divided by their language of instruction—Hebrew in the Jewish sector and Arabic in the Arab sector. Within each sector, schools are grouped under supervision frameworks that represent different cultural and religious subsectors in Israel. Within the Jewish sector, these frameworks include secular, religious, and ultra-orthodox supervision; within the Arab sector, there are separate supervisory bodies for the Arab, Bedouin, and Druze populations. Under each supervision framework, the curriculum has different content and a different proportion of religious and cultural studies. However, the curriculum for core subjects, including mathematics and science and technology at both the primary and lower secondary levels, has no special tracks associated with it and serves all students equally.[a]

The primary and lower secondary mathematics curricula have undergone intensive revision over the last decade. The current mathematics curriculum for primary schools was published in 2006,[2] and for lower secondary schools in 2009,[3] with a focus on generating continuity between

[a] This report compiles both official sources and personal communication with the Chief Inspector of Science and Technology Studies and the Chief Inspector of Mathematics Studies.

the mathematics taught at the primary and the lower secondary levels. The new curricula join the two levels in a spiral teaching progression that integrates the mathematical knowledge covered at the primary level into new mathematics subjects taught at the lower secondary level; the subjects initially covered at the primary level are revisited and expanded on at the lower secondary level. Further, the subject domains of Geometry and Numbers, which are central to the primary curriculum, were integrated into the curriculum of the three grades of lower secondary school, to accompany the Algebra domain that was the focus of the previous curriculum. In the updated lower secondary curriculum, the domains of Algebra, Geometry, and Numbers (including statistics and probability) are merged into one subject, in a way that cultivates students' ability to use multidomain problem solving methods. Curricula at both the primary and lower secondary levels focus on different aspects of mathematical literacy development.

In science and technology, the learning curricula at both the primary and the lower secondary levels are based on Tomorrow 98,[4] a program developed in the 1990s within the scope of national science and technology education reform that treated science and technology as integrated areas of learning. Following the STS (Science, Technology, and Society) approach, a curriculum was designed for the lower secondary level, focusing on the acquisition of scientific and technological literacy. Novel learning materials were developed within the scope of the new curriculum, providing teachers with a variety of topics in each of the scientific disciplines (physics, chemistry, biology, and Earth science) and with extensive autonomy to choose among them. Regional centers for professional development were established to educate teachers on the new curriculum and learning materials.

Beginning in 2009, the national Strategic Plan to Strengthen Science and Technology was established to strengthen science and technology education.[5] Within the scope of this program, the curriculum for lower secondary schools was revised, and the corresponding learning materials extensively rewritten. During this process, technology was separated from the scientific disciplines, and topics were clearly defined within each discipline. The teaching sequence in Grades 7 to 9 was reconfigured in a spiral progression adapted to students' cognitive developmental stages. Earth science was moved from the science and technology curriculum to the geography curriculum[6] (which is available in most schools).

A national program initiated in 2011, Adapting the Educational System to the 21st Century, aims to create learning environments in which technology serves the development of innovative pedagogy and 21st century skills. The program includes teacher training workshops focused on enhancing teachers' technological pedagogical content knowledge to aid them in creating computer-based learning environments, implementing instructional materials effectively, and generating a learning continuum for students between school and home.

Establishing a suitable infrastructure (i.e., computers, laboratories, and a shift toward using them as part of routine instruction) became a priority as a result of instructional reforms in mathematics, science, and technology. In mathematics, the use of computers is expanding in both elementary and secondary schools. Teachers direct students to use existing mathematics

applets and mathematical software such as Desmos, Geogebra, etc. These computer applications are used for illustration, discovery and research. Digital literacy tasks in mathematics, science and language were developed by the Ministry of Education for students in the secondary schools. In mathematics, calculators (non-graphing) are commonly used, beginning in the lower secondary grades. In science, the use of computers is more integral to teaching, especially for literature searches, data processing, simulations, and models. As part of this program, teachers participate in Information and Communications Technology (ICT) professional development—a variety of courses to acquire computer technology skills.

In 2014, a national strategic plan was developed to help shift the focus from student achievement, as measured by tests, to the processes of learning and teaching (Strategic Plan for Meaningful Learning, Israel's Education Moves Up a Grade, and Israel *Olah Kita*).[7] Within the scope of the new plan, several subject curricula were revised, especially in terms of syllabus organization, teaching instructions, and assessment formats. The new strategic plan has had a definite impact on science and technology curricula, while the mathematics curriculum has remained largely unchanged (following a decision made by the Ministry of Education).

In both mathematics and science and technology, regional inspectorates continually monitor the implementation of the defined content in the selected teaching sequence as determined by the new curricula in schools. Experienced teachers are selected and trained as pedagogical instructors to help classroom teachers stay up to date with the curricula. In mathematics, each pedagogical instructor is assigned 8 to 10 schools and works with classroom teachers. In 3 to 4 schools, they work intensively, while the rest are instructed based on the teacher's requests. In science and technology, each instructor works with teachers in 8 lower secondary schools.

Hebrew and Arabic are the two official languages spoken in Israel. Hebrew is the main spoken language, widely used in business, government, academia, and the media. Other languages associated with recent waves of immigration, such as Russian and Amharic, also are spoken in Israel.

At the end of 2019, there were approximately 1.8 million students studying in K–12 classes in Israel. The languages of instruction in Israel are Hebrew and Arabic. Students in the Jewish sector receive instruction in Hebrew, and students in the Arab sector receive instruction in Arabic, in all subjects. In Hebrew sector schools, English is studied as a second language, usually from the third or fourth grade. Arabic is studied in lower secondary school as a third language and is an elective major in high school. In Arab sector schools, Hebrew is studied as a second language, and English is studied as a foreign language, usually from the third or fourth grade. The curricula for mathematics and science and technology are written in Hebrew and translated into Arabic. All learning materials written in Hebrew are translated into Arabic to ensure students in the two sectors receive similar instruction. National tests are written in Hebrew and translated into Arabic, and international tests are translated from English into Hebrew and Arabic. Because Israel is a country of immigrants, special attention is given to immigrant students. In accordance with this policy, new immigrant students receive special instruction in Hebrew as a second language for

approximately four years to support their integration into regular classroom instruction, conducted in Hebrew. Further assistance is provided according to individual student needs.

Use and Impact of TIMSS

Israel has been participating in TIMSS at the eighth grade since 1999. During this period, the curricula for mathematics and science at the primary and lower secondary levels have undergone revision, and new standards have been adopted. In mathematics, the domains covered at the primary and lower secondary levels were aligned to generate a link between the primary and lower secondary curricula. In science, topics were reorganized to fit the designated instructional hours, and a teaching sequence was determined.

TIMSS provides valid and reliable information about the Israeli education system from an international perspective. An objective comparison with other education systems in the world is a valuable resource for policymakers investigating the strengths and weaknesses of the education system in Israel. Furthermore, participation in these international studies enables Israel to learn about new and current approaches to teaching mathematics and science, and to examine its own curricula in relation to curricular approaches in other countries.

The Mathematics Curriculum in Primary and Lower Secondary Grades

Both the primary and the lower secondary mathematics curricula in Israel have undergone intensive revision over the last decade. In 2002, a committee[8] was appointed to examine mathematics teaching at all grade levels and to recommend improvements. The committee identified several deficiencies related to mathematics teaching, including a lack of sufficient instruction on solving word problems, a tendency to narrow the curriculum to topics that appear on matriculation examinations, and a lack of sufficient geometry instruction (compared with algebra) in lower secondary school. In addition, the committee identified the ethnic as well as socioeconomic achievement gaps between subpopulations in Israel as indicators of low achievement. At approximately the same time the committee's recommendations were published, other committees[9,10] appointed to examine the pedagogical approaches reflected in learning materials concluded that the most common instructional approach emphasized arithmetic skills and neglected mathematical reasoning and that the curricula for primary and secondary mathematics education were not connected in a learning progression. In addition, the committees found the conditions for teaching mathematics to be inadequate: classrooms were crowded and populated with students at disparate levels, teachers lacked sufficient subject knowledge, and there were not enough instructors in the field.

In 2003, the Quantitative Reasoning Program was implemented in approximately half of lower secondary schools in Israel. This intervention emphasized the study of six topics related to quantitative thinking, establishing a link between the mathematics taught at the primary and lower secondary levels and improving students' ability to solve mathematical problems that require them to integrate skills learned in other school subjects. The intervention program went

through several cycles of revision and was the first step in the development of a new curriculum for lower secondary schools introduced in 2009.

The goal of the new 2006 primary level curriculum is for students to learn basic concepts and structures in the Numbers and Geometry domains, as well as develop mathematical skills and abilities, such as number sense and geometric insight, computational skills, the ability to use mathematical tools to solve word problems, and conceptual understanding and knowledge of mathematical language.[11] Attaining mathematical concepts is considered a cumulative process dependent on students' ability to grasp mathematical concepts and link them to other school subjects and the real world. The primary mathematics school curriculum, up to fourth grade, includes the following topics:

- Numbers and Operation, and Data Investigation—Natural numbers, the four arithmetic operations (addition, subtraction, multiplication, and division), fractions (arithmetic operations, common denominators, and decimal equivalents), percentages, and proportion
- Geometry and Measurement—Geometric shapes (two-dimensional shapes, such as polygons, triangles, squares, and rectangles, and three-dimensional shapes, such as rectangular prisms); measurement of length, area, volume, angles, etc.; transformations and symmetry; properties of quadrilaterals; circles; classification of three-dimensional shapes; and computation of volume

In 2009, a new mathematics curriculum was developed at the lower secondary level. The curriculum integrates the mathematical knowledge learned in primary school with new and more advanced topics in lower secondary school and uses a spiral approach to curricular planning to expand on topics previously taught. This spiral sequencing enables students to return to basic ideas as new topics and concepts are continually added over the course of the curriculum, to solidify and deepen understanding and knowledge. The curriculum merges three domains—Numbers, Algebra, and Geometry—and cultivates students' ability to use multidomain problem solving methods. The new curriculum is intended to include at least 150 instructional hours in each grade and includes recommendations concerning the allocation of instructional hours to help teachers with planning. Exhibit 1 presents the allocation of instructional hours for mathematics content domains.

Exhibit 1: Instructional Hours for Mathematics, Grades 7 to 9

Grade	Content Domain	Instructional Hours
7	Numbers	70
	Algebra	30
	Geometry	50
8	Numbers	70
	Algebra	50
	Geometry	30
9	Algebra	65
	Numbers	15
	Geometry	70

The main mathematics topics are distributed over the three grade levels of lower secondary school, as presented in Exhibit 2 (subjects for Grade 8 are described in greater detail).[12]

Exhibit 2: Mathematics Topics, Grades 7 to 9

Grade	Content Domain	Percentage of Curriculum	Topics
7	Numbers	20	Negative numbers, fractions and decimals, and the Cartesian Plane.
	Algebra	45	Patterns, algebraic expressions, equations, and introduction to functions.
	Geometry	35	Perimeter and area (rectangles, triangles, parallelograms, rhombuses, and trapezoids), volume and surface area (cubes and boxes), and measurements of length, area, volume, and angles. Introduction to proofs in geometry (basic concepts of theorems of triangles and angles).
8	Numbers	32	Ratio and proportion, percentage, descriptive statistics, chance, real numbers, and square roots. Ratio is a major theme later in Grade 8 and includes a variety of topics (scale, proportion, similarity of triangles, the slope of a straight line, linear functions of the form $y = mx$, percentages, relative frequency, and probability).
	Algebra	48	Algebraic expressions; linear functions; solving equations, inequalities, and simultaneous equations; and using linear functions to solve problems. The concept of linear functions lays a foundation for studying methods for solving linear equations, systems of linear equations with two unknowns, inequalities, equations with absolute values, and word problems whose solutions involve these methods.

Grade	Content Domain	Percentage of Curriculum	Topics
	Geometry	20	Geometric shapes and Euclidean geometry, including triangle congruence, properties of isosceles triangles, similar triangles, the Pythagorean theorem (including its use in the coordinate plane), theorems, and proofs. The key concepts taught in eighth grade geometry are isosceles triangles and similar triangles, which serve as a basis for further studies of deductive proof in geometry. Attention is directed mainly toward enhancing student awareness of the correctness and logic of statements of congruence and similarity, and why the conditions set forth in congruence and similarity theorems are necessary and sufficient.
9	Algebra	44	Advanced algebraic expressions and algebraic techniques, exponents and exponentiation expressions, quadratic functions (graphs and properties and quadratic equations, and understanding different kinds of functions and their graphs and properties). All topics include solving word problems and conventional and real world problems.
	Numbers	10	Probability and graphs.
	Geometry	46	Euclidean geometry-theorems and proofs of triangles (isosceles, equilateral, and right triangles), and quadrilaterals.

The Science Curriculum in Primary and Lower Secondary Grades

Since the early 1990s, the science curriculum in Israel at both the primary and lower secondary levels has focused on science and technology literacy and has included the mastery of significant facts, concepts, principles, and theories in science and technology; a grasp of scientific and technological processes and their impact on society; and the ability to use this knowledge to serve the needs of individuals and society. In addition to presenting the key concepts and ideas of science and technology, the general objectives of the curriculum are to highlight the similarities and differences between the two disciplines; to indicate their potential contributions to society and their limitations; and to develop students' intellectual competencies, such as inquiry and decision making skills, as well as performance skills in design and practical problem solving.

In general, the study of science is not compulsory beyond the lower secondary level. Students are not required to study toward a matriculation certificate in science and technology, and thus many end their science studies in 10th grade.

The science and technology curriculum at the primary level includes six content domains and a set of cognitive and practical skills to be attained.[13] The content domains are Matter, Energy, The Manmade World, Systems and Processes in Living Organisms, Ecosystems, and The Earth and the Universe. Each domain is divided into subdomains that contain a specified and detailed list of topics. These topics are further elaborated into a scheme of standards for each grade level. Each standard describes the scientific, technological, and societal aspects of every topic.

The topics are designated into six levels (one level for each grade), and the learning progression is planned in a spiral that takes students from one level to the next as they advance through the appropriate cognitive developmental stages. The syllabus does not define the sequencing of topics, and teachers are encouraged to sequence and connect topics meaningfully based on their specific pedagogical beliefs and educational contexts.

In addition to defining content domains, the curriculum defines how students may attain cognitive and performance skills. This component is woven into the content objectives. The curriculum identifies three non-mutually exclusive groups of skills that highlight different aspects of scientific practice: information processing and handling, inquiry, and problem solving skills.

The curriculum at the lower secondary level comprises the same domains as the curriculum at the primary level (except The Earth and the Universe, which is included under the geography curriculum, and replaced by Cell Structure and Function). Building on the primary school syllabus, the science and technology curriculum at the lower secondary level imparts basic concepts, modes of thought, and inquiry and problem solving strategies in science and technology, with the benefit of the entire population in mind. The curriculum provides a foundation for students who will major in other disciplines and forms a basis for advanced science and technology studies for students choosing to major in these disciplines. In 2013, compulsory hands-on activities, designed to be performed by students in laboratories, were added to the curriculum in all the scientific domains and cognitive skill areas. The main science topics are distributed over the three grade levels of lower secondary school, as presented in Exhibit 3 (subjects for Grade 8 are described in greater detail).[14] The curriculum also recommends that an investigative problem solving project be integrated with the scientific contents of one of the domains in ninth grade.

Exhibit 3: Science Topics, Grades 7 to 9

Grade	Content Domain	Percentage of Curriculum	Topics
7	Materials	12	Properties and uses
		30	Physical changes in matter
	Energy	8	Forms and transformations
	Cell structure and function	8	
	Systems and processes in living things	34	Circulatory system
	Design processes	8	Technology
8	Electricity and magnetism	10	Electric charge and current; energy transformation in electrical circuits; electricity and safety; renewable and nonrenewable sources of energy; energy production, usage, and ecological cost

Grade	Content Domain	Percentage of Curriculum	Topics
	Forces and motion	13	Interaction, forces and changes, daily use of forces, simple machines and levers, movement and speed
	Materials: elements, compounds, and mixtures	30	Elements, the atomic model, the periodic table; material changes (chemical reactions); mixtures; conservation of matter; energy transformations; ecological cost of the use of materials
	Cell structure and function	4	Genetic material (DNA) in cells, function and organization in chromosomes; all cells come from other cells; cell division, mitosis and meiosis; structure-function relationship of cells; sperm and egg cells; differentiation
	Systems and processes of living organisms: reproduction	23	Reproductive system; fertilization; embryonic development; maturation; mate finding
	Ecosystems	13	Interactions between living organisms in the ecosystem; materials and energy transitions in the ecosystem; ecological balance and human impact; biological diversity
	Technological systems	7	
	Earth science	Additional subject	Astronomy; geology (internal forces) and geomorphology (external forces); climate and weather; and the Earth's resources
9	Materials	20	Chemical bonds; carbon and its compounds; and the influence of human usage of materials on society and the environment
	Cell structure and function	10	
	Systems and processes in living organisms	30	Nutrition and heredity
	Physics and technology	40	Energy and technological systems; the impact of energy uses on individuals, society, and environment

The cognitive skills and processes in the science curriculum are divided into three main categories: the process of inquiry, problem solving skills, and information management. The information management skill category is subdivided into locating, collecting, and transferring data; processing and representing data; and presenting knowledge through writing and speaking. The other skill categories—inquiry and problem solving—incorporate typical scientific and technological processes, such as planning and processing an investigation, managing information, conducting data analysis, and drawing conclusions. In addition, the curriculum describes cognitive skills such as strategic thinking, logical and critical thinking, reflective thinking, probability thinking, and creative thinking.

Professional Development Requirements and Programs

In 2009, an educational reform, New Horizon (*Ofek Hadash*),[15] was initiated at the national level for primary and lower secondary schools, and four main goals were set forth: strengthening the status of teachers and raising their salaries; ensuring equal opportunity for every student, raising student achievement, and narrowing education gaps; improving school climate; and empowering principals and extending their authority in schools. The reform gives principals greater responsibility for teacher evaluation and performance and exemplifies a trend toward increasing the accountability of schools for quality of instruction and student outcomes. The reform establishes a scale of promotion for teachers and principals, constructs the process of teacher evaluation in a way that reflects the complexity of their work, and creates a common language for all those involved with teacher evaluation in the different arenas of the school system (both within the Ministry of Education and outside—i.e., inspectors, principals, teachers, academics, etc.). The reform strongly reflects the "no child left behind" rationale and makes provisions for its implementation in schools—i.e., dedicated time in teachers' daily schedules for helping students with learning difficulties as well as exceptional students.

According to the new reform, all primary and lower secondary school teachers are required to complete at least 30 hours of in-service training per year, every year, at least half of it in their professional domain. The number of the training hours that teachers choose each year must align with the recommended training hours, corresponding to their professional rank within the defined scale of promotion.

The professional development framework includes four domains of training: subject matter programs, which are designated for the teachers trained to teach the specific subject (e.g., language, mathematics, science, and technology); wide-purpose programs, which are suitable for all kinds of professional development and teachers; designated programs for specific positions or subjects (e.g., the first year induction workshop); and teacher-role programs, which are designated to develop teachers for fulfilling specific roles in the school (e.g., class management, leader teachers, subject coordinator).

There are four options to facilitate the implementation of the professional development framework: group training intended to facilitate the implementation of policy; task-oriented training for principals, coordinators, and leaders (initiated by the Ministry of Education); school-based training for addressing the needs of individual schools; and personal training for professional enrichment and further education. Most schools offer institutional in-service training, planned by the principal and managerial staff.

Professional Development Requirements for Mathematics and Science Teachers

The Ministry of Education recommends science and technology be taught by teachers with an academic background in a scientific discipline or specific training for science education starting in third grade. The Ministry recommends mathematics be taught by teachers with an academic background in mathematics or specific training for mathematics education starting in first grade.

In-service teachers in primary schools qualify as science and mathematics teachers by participating in extensive professional development programs at colleges for education. In spite of the recommendations and policies of the Ministry of Education, however, many teachers still are not qualified. This situation is due to a shortage of suitable candidates for available positions, mostly in primary schools. At present, approximately 50 percent of science teachers at the primary level have a scientific background that matches the criteria established by the Ministry of Education. Typically, science is taught by homeroom teachers in Grades 1 to 2, by comprehensive teachers in Grades 3 to 4, and by science teachers in Grades 5 to 6.

At the lower secondary level, all mathematics and science teachers hold the required qualification—either a Bachelor of Science (or higher), or a Bachelor of Education with specific training in mathematics or science education. Most also hold a teaching certificate and license. Most science teachers hold a teaching certificate in biology and/or chemistry.

In each school, one mathematics teacher and one science and technology teacher serve as subject coordinators, instructing the other teachers and participating in the development of school learning programs and evaluation policies for their respective subject. Pedagogical instructors (experienced teachers selected to help in-service teachers stay up to date with the content knowledge and sequencing defined in school learning programs) periodically visit schools. Pedagogical instructors in mathematics are assigned to work with teachers at all grade levels in five lower secondary schools, while instructors in science and technology are assigned to work with teachers in eight lower secondary schools.

In-service professional development programs are planned in each subject, according to recommendations made by policymakers, and implemented by special professional development centers for in-service teachers, and by universities and colleges of education. Among the courses and workshops offered are courses for primary school teachers pursuing qualification in mathematics and science and technology, as well as courses for strengthening geography content knowledge and pedagogical content knowledge, courses to facilitate implementing of curricular adjustments and modifications, and designated courses to advance innovative teaching strategies or to advance specific skills or competencies that are relevant to the subject matter.

Within the professional development framework, in-service training in mathematics and science was expanded to help teachers with the new curricula. Qualified instructors (experienced teachers who have completed extensive professional development led by mathematics and science education specialists) provide intensive training for primary school teachers. As most science teachers hold a teaching license in biology or chemistry, the physics component of the in-service trainings is enhanced.

Over the past few years, colleges of education have begun to offer an alternative pathway to obtaining a teaching certificate for career changers (candidates who hold a bachelor's degree and have a few years of work experience in another field). Most candidates for a teaching certificate in mathematics and science and technology come from careers in mathematics and science, such as high-tech and engineering careers. The programs for career changers typically last two years and

focus on the basic pedagogical component of the full four-year program. Certain colleges of education offer the option of combining a master's degree in education (M.Teach) with a teaching certificate. Every program requires teachers to complete an induction year before a teaching license may be granted. In-service primary school teachers can also obtain a qualification to teach science and mathematics by participating in extensive professional development programs at colleges of education.

Since 2016, professional disciplinary communities of teachers have been established all over the country. These "professional learning communities" each comprise about 20 teachers. They meet once every other week (sometimes online), and teachers share their experience and learn and develop new materials and new teaching strategies.

The recruitment of teachers with an academic background in mathematics and science at the primary and lower secondary levels has always been a challenge, and despite efforts made through different programs, it remains a challenge.

Monitoring Student Progress in Mathematics and Science

Student progress in mathematics and science, as in other subjects, is monitored by internal and external evaluation systems. The internal evaluation system in schools is administered by school staff and constitutes the central component of the teaching-learning assessment process. The evaluation is based on schools' internal tests and assessment of student activities and projects. Student reports are distributed at least twice a year, and student achievement is reported using numerical grades (on a scale up to 100), accompanied by descriptive grades (i.e., Excellent for 95 to 100, Very Good for 85 to 95, and so on). Most primary schools use descriptive grades accompanied by written evaluations through the fourth grade.

The National Authority for Measurement and Assessment in Education (known by its Hebrew acronym, *RAMA*)[16] was founded in 2005 to address the need for professional measurement, evaluation, and assessment in the education system. The ideological framework for *RAMA's* activities is based on two principles: establishing an assessment for learning and designing a variety of professional solutions that integrate different components of measurement and assessment. The format of Israel's national assessment system (known as *Meitzav*[17] the Hebrew acronym for GEMS, which stands for the Growth and Efficiency Measures of Schools) integrates internal and external assessment and promotes a culture of "measurement for learning." *Meitzav* is intended to support the continual improvement of learning through the alignment of learning goals with school vision and is based on the premise that test results are not a goal in themselves but rather an instrument for improving learning outcomes.

Meitzav includes student achievement tests and questionnaires regarding school climate and pedagogical setting (administered to principals, teachers, and students). At the school level, the system is designed to serve principals and teaching staff as a tool for planning and allocating resources, realizing student potential, improving the pedagogical climate, and enhancing the school instructional system. At the national level, *Meitzav* is designed to provide a picture of

student achievement in the four core subjects and to inform policy on various education issues, including climate and pedagogical setting.

The *Meitzav* achievement tests, first introduced in 2002, originally focused on the four core subjects of Mathematics, Native Language (Hebrew or Arabic), English, and Science and Technology. The assessments were administered to students at the fifth and eighth grade levels and were designed to measure students against the standards set forth in the national curricula. Following a one-year hiatus in 2014, a new cycle of testing was launched—a three-year cycle in which one-third of the schools were tested externally (External *Meitzav*) each year. Other schools administered the same test forms internally (Internal *Meitzav*). In October 2019, a new evaluation model was announced that will combine external and internal evaluation with a greater emphasis on formative assessment. This model will be implemented beginning in 2020.

Matriculation examinations (*Bagrut*)[18] are regarded as the official tests for measuring the results of the 13 years of compulsory schooling in Israel. The examination process is governed by the Ministry of Education and creates a standard measure of student knowledge throughout the country. The option to participate in the matriculation examinations is open to every high school student. These high stakes examinations, taken in the 11th and 12th grades, cover all subject areas taught in secondary school, and typically are used to determine access to higher education.

The subjects studied in Grades 10 to 12 are divided into core subjects and elective subjects, both of which are compulsory. The depth and scope of study for each subject is reflected in the corresponding matriculation examination in terms of learning units. Each learning unit represents approximately 90 hours of study in an academic year, and the number of units for each subject ranges from 1 to 5. A matriculation certificate is awarded to students who are tested in at least 21 learning units in core subjects and at least 5 learning units in one elective subject (as stipulated in the national criteria). A student's final grade in each subject comprises the average of his or her school examination results and state examination results. Students whose combination of subjects does not qualify them for a matriculation certificate are awarded a school final certificate. The examination levels are structured in a modular fashion, enabling students to progress from a lower examination level to a higher one, or to repeat a test to improve their grade. Students who graduate with a school final certificate may go on to complete the required examinations and obtain a matriculation certificate after graduation.

Mathematics and English as a Foreign Language are core compulsory subjects. These subjects have three levels of study, each comprising 3, 4, or 5 learning units. (The advanced levels comprise 4 or 5 learning units, while the basic level comprises 3 learning units.) In the Hebrew sector, Hebrew language (grammar and writing), literature, and Bible studies, and history (usually studied at a basic level of 2 learning units each) are compulsory, in addition to civics (1 learning unit). In the Arab sector, the equivalent compulsory subjects are Arabic language (grammar and literature) and history (2 learning units each), civics (1 learning unit), and Hebrew language (2 learning units or higher).

There are more than 50 compulsory elective subjects, representing a variety of learning domains, to accommodate the wide range of abilities and interests among students. The subjects are taken from the disciplines of science and technology, the humanities (including Hebrew language and literature for the Jewish sector, and Arabic and Hebrew languages for the Arab sector), social sciences, and the arts. Students must complete 5 learning units in at least one of these subjects to obtain a matriculation certificate. The science and technology disciplines comprise physics, chemistry, biology, Earth sciences, environmental sciences, agriculture, biotechnology, and computer sciences. Laboratory examinations constitute part of the 5 learning units in most of these science majors. Students can choose to specialize in any core subject and take the corresponding matriculation examination at the highest level of 5 learning units. Since 2015, it has been compulsory for students who do not major in at least one scientific discipline to complete science and technology studies at the basic level (1 learning unit).

Students with diagnosed learning disabilities have the right to special accommodations in the learning process, in internal school assessments, and on national matriculation examinations, in particular. Testing accommodations may include oral examination and/or a time extension. On the national standardized achievement test in the fifth and eighth grades (*Meitzav*), all students are allowed a time extension of 15 minutes in each of the core subjects—mathematics, native language (Hebrew or Arabic), English, and science and technology. In addition, in mathematics, English, and science and technology, students with diagnosed learning disabilities may be tested in an accommodated classroom in which the tests are read aloud by teachers as needed. The number of examinees in these classrooms is limited.

Special Initiatives in Mathematics and Science Education

After a decrease over several years in the rate of students majoring in mathematics and the sciences, the Ministry of Education has set objectives with the goal of increasing the number of high school students choosing to major in scientific disciplines and advanced mathematics, especially considering these majors may lead students to STEM (science, technology, engineering, and mathematics) professions. Additional efforts are being made to help low achieving students in mathematics who may be at risk of dropping the subject to complete the basic level of 3 learning units. The main initiatives in science and mathematics education implemented in lower secondary and secondary schools are described as follows:

- Science and Technology Future Professionals (*Atuda Madait-Technologit*)[19]—Begun in 2011, this program aims to attract students at the lower secondary level to advanced science, technology, mathematics, and computer studies beginning in the seventh grade, with a view to promoting excellence in these subjects and increasing the rate of students taking 5 units of mathematics and science and technology by the end of secondary school. Approximately 260 schools now participate in this program. Additional instructional hours in mathematics, physics, computer science, and robotics are allocated for students in the program, beyond the compulsory science and technology and mathematics hours

in regular classes. Students explore additional topics beyond the compulsory curriculum, and study topics within the curriculum in depth. Teachers in this program participate in workshops designed to help them with the extended curriculum, and schools are equipped to provide additional laboratory activities. At the secondary level, students in the program are expected to study advanced mathematics at the 5 unit level and major in two subjects within science and technology (i.e., physics, chemistry, biology, computer science, or biotechnology). To help students succeed in the program, additional hours are allocated for learning in small groups.

- Make the Most of Their Potential and Promote Excellence in Mathematics (*Mitzui ve-Metzuyanut*)[20]—Implemented in 2010 in the majority of lower secondary schools, this program aimed to meet the needs of students at the two ends of the achievement spectrum. In addition to their regular classes, advanced students participated in one to two additional hours of mathematics instruction dedicated to enrichment activities beyond the regular syllabus. These activities were designed to enhance motivation and promote interest in the field of mathematics and lay a foundation for studying advanced mathematics at the 5 unit level in secondary school. At the other end of the spectrum, students with difficulties in mathematics, who may be at risk of dropping the subject in secondary school, were assigned to the Make the Most of Their Potential program. In this program, students worked in small groups, and teachers dedicated special efforts to addressing their difficulties in mathematics, extending their base of mathematical knowledge, and strengthening their sense of self-efficacy and self-confidence to prepare them for studying basic mathematics at the 3 unit level in secondary school. Since 2016, only schools with very low achievement get extra hours, especially for the students at the two ends of the achievement spectrum.
- Beginning in 2016, the Ministry of Education allocated two extra hours in mathematics to ninth grade students to strengthen and encourage them to fulfill their potential in mathematics and study higher level mathematics. This program is for students who need additional support to attain the knowledge needed for high level mathematics.
- The National Plan to Strengthen Mathematics (*Latet 5 or 5 Pi 2*)[21]—Established in 2014, this national program aims to increase the number of students who choose to study mathematics at the 5 unit level in secondary school. The program is carried out in collaboration with nongovernmental organizations and experts from academia, and includes allocating additional instructional hours for students at the 5 unit level to study in small groups (during the academic year and in summer courses); promoting activities among school principals, mathematics teachers, and students that highlight the importance of learning advanced mathematics; establishing a forum for policymakers, representatives of high tech and industry, and experts in mathematics education to discuss ways to promote interest in mathematics; establishing professional communities and special workshops for mathematics teachers to provide professional development and support; recruiting high quality candidates to attractive career change programs; and creating an incentive for students to take the 5 units mathematics matriculation

examination—i.e., counting their test scores as an advantage in the university admissions process. Due to achievement gaps between the central areas and the periphery of the country, the Ministry of Education allocated a special budget, beginning in 2018, to provide educational and emotional support for schools, teachers, and students to address these gaps.

Suggested Readings

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