

Exhibit 18: National Policies Regarding Use of Information and Communications Technology (ICT) and Digital Devices in Mathematics and Science Instruction at the Fourth Grade

Reported by National Research Coordinators

Country	Description of the National Policies for Use of Information and Communications Technology (ICT) and Digital Devices	
	Mathematics Instruction	Science Instruction
Albania	The national curriculum contains statements about the use of digital devices organized around developing digital competencies in mathematics, such as collecting, organizing, and displaying data..	A document provided by the Agency of Quality Assurance describes the policies. Students are expected to develop digital competencies, such as communication, collaboration, and using technologies to collect, organize, analyze, and display data.
Armenia	No policy	No policy
Australia	The use of digital devices is encouraged but not mandated. The F–10 Australian Curriculum includes general capabilities, including ICT capability, that are expected to be addressed through the learning areas, including mathematics. The mathematics curriculum content descriptions refer to "using appropriate digital technologies."	Same as for mathematics
Austria	Computers should be used for learning and creative working in all subjects. There are no subject-specific policies, but digital education is an important aspect of the new curriculum.	Same as for mathematics
Azerbaijan	No policy	No policy
Bahrain	The Ministry of Education implements 2 major projects related to e-learning: the King Hamad Project for Future Schools and the Digital Empowerment in Education project. Both projects entail the use of digital devices and include e-lessons and digital enrichments that students can access in class and at home through the Ministry's portal. Classes are also equipped with smart/interactive boards.	Same as for mathematics
Belgium (Flemish)	Policies vary by schools' curricula. Typically, students begin using 4-function calculators in Grade 4. They are also expected to use media to explore software, develop technical skills, find information through search strategies, store information, create PowerPoint presentations, and present information to others. Students should be able to choose appropriate devices for their needs and explain their reasoning.	Policies vary by schools' curricula. Although there are no explicit policies for science, students are expected to develop basic ICT skills starting at Grade 4 (same as mathematics).
Bosnia and Herzegovina	No policy	No policy
Bulgaria	Currently, there is only a statement about practical skills for using a calculator. However, a new act coming into effect with the new curriculum for 2019 includes policies for twenty-first century skill development as well as the use of ICT and other technologies.	Same as for mathematics
Canada	Calculators, spreadsheets, databases, and hypertext technology are used to solve problems that require sorting, organizing, classifying, and extending data.	Same as for mathematics
Chile	Digital tools such as computers and calculators support the learning environment by enabling students to explore patterns and relationships in geometrical settings and simple equations, to test hypotheses, present data, and support calculations. ICT can be used to enhance the learning process in Grades 1–4, although it is expected that students understand and apply the relevant concepts before using these tools.	ICT is considered a relevant skill to register and communicate information, and to promote scientific ideas. It is expected that students become more familiar with ICT in the development of scientific knowledge.
Chinese Taipei	Once students have learned basic computational skills, teachers can introduce technology aids for solving mathematics problems. Calculators should not interfere with teaching concepts and are typically used only in junior and senior high school.	Teachers should teach with various media and resources, including computers and the internet, to engage students in searching for information.
Croatia	In the current Teaching Plan and Program, there are no recommendations for using calculators, tablets, and computers in Grade 4 mathematics classes. However, beginning in 2021, the new curriculum will emphasize the use of digital technology in teaching and learning.	Same as for mathematics
Cyprus	Technology should be used when it will add value to the conceptual development of mathematical ideas.	The national curriculum includes a provision for fostering multiple key competences, including the fluent, valid, and considerate use of ICT.
Czech Republic	No policy	No policy
Denmark	According to the national curriculum, students can use digital devices and applications in teaching activities, but the use of computers is not mandatory.	Same policy as for mathematics

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	Mathematics Instruction	Science Instruction
England	According to the national curriculum, ICT, including calculators, should not be used as a substitute for good written and mental arithmetic. It should be introduced near the end of Key Stage 2 (Grades 2–5) to support students' conceptual understanding and exploration of more complex number problems if written and mental arithmetic are secure. Teachers should use their judgment about when ICT tools should be used.	No policy
Finland	Programming is integrated into mathematics instruction. One of the objectives of instruction is to inspire students to design algorithms in the form of computer programs in graphic programming environments. ICT and calculators are used in teaching and learning. Education providers and teachers can decide what types of digital devices to use.	ICT is integrated into science instruction. One of the objectives of instruction is to direct students to use ICT responsibly and ergonomically as a means of interaction, and for acquiring, processing, and presenting information.
France	According to the mathematics curriculum, calculators should be used to implement and check arithmetic. Computers should be used to help better organize work and create digital models.	According to the science curriculum, computers should be used to model reality.
Georgia	In compliance with the national curriculum, a student should use different means of communication during class, including ICT.	Same as for mathematics
Germany	Policies vary by state. In North Rhine-Westphalia, ICT, and traditional media (e.g. books, TV, radio), are learning aids and instructional topics. In primary school, students are introduced to important sources of information and how to make meaningful use of ICT. Media is also taught as its own subject, in which students learn about the nature of a reality shaped by current technologies. Media literacy is developed through systematically working with media.	Same as for mathematics
Hong Kong SAR	Calculators are used to facilitate learning mathematics, rather than to replace mental arithmetic and written calculation. Students can use calculators to analyze number patterns and constructs, as well as check different methods and results of problem solving. Students may also be taught to use appropriate computer software to explore number patterns and characteristics of shapes, draw figures and statistical graphs, and analyze data and compile reports. Students are guided in using the internet to collect relevant mathematical information, enrich what they are currently learning, and explore real-world applications.	No policy
Hungary	Electronic devices, such as calculators, computers, and graphical calculators, along with the internet and courseware, are used to develop students' digital competence.	No policy
Iran, Islamic Rep. of	Students may use calculators in class, with the exception of when they are learning to compute. Calculator-based activities are also provided in mathematics textbooks.	No explicit policy, but there are activities in the science curriculum that require calculators or computers.
Ireland	The primary mathematics teacher guidelines provide guidance on the use of technology within the primary mathematics curriculum, specifically in support of using calculators and ICT in the classroom. The Digital Strategy for Schools 2015–2020, published by the Department of Education and Skills, outlines the government's action plan for integrating ICT into teaching, learning, and assessment practices in schools.	There is no explicit policy for the use of digital devices in Grade 4 science instruction. However, strong links are made between science and technology, and the role of technology in exploring science.
Italy	The objectives for digital education are primarily established in the National Plan for Digital Education (<i>Piano Nazionale Scuola Digitale</i> ; PNSD). It is organized into 35 broad actions, covering all of the areas connected to the development of ICT in public education. ICT and its use in education is viewed as a transversal objective, necessary to fulfill the requirements of each subject.	Same as for mathematics
Japan	When necessary, computers and other digital devices should be used to enrich students' sense of numbers, quantities, and geometric figures, and to improve their ability to represent data by using tables and graphs.	Appropriate digital devices, such as computers and audiovisual aids, should be used for instruction on observations, experiments, cultivation, raising animals, and making learning materials.
Kazakhstan	No policy	No policy

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Korea, Rep. of	The Guidelines for Teaching and Learning and Assessment state that learning with media and tools arouses students' interest and promotes effectiveness and diversity of learning. Audiovisual material, multimedia and internet, teaching aids, calculators, and educational software can be used. Teachers should make use of these tools to help students perform complicated computations, gain a deeper understanding of mathematical concepts, and develop problem-solving skills in situations that do not pertain directly to computation. Assessments of learning in mathematics provide students with opportunities to use different technological tools depending on the learning content and the methods of assessment.	The scientific communication skills included in the curriculum relate to the comprehension and expression of scientific and technical information through a variety of media such as models, audiovisual materials, software, computers, smart devices, and the internet. In addition, teachers should instruct students on mathematical thinking and computer use as it relates to learning different topics.
Kosovo	The curriculum guidance documents describe the methodology for the use of digital devices and provide resources for teachers.	Same as for mathematics
Kuwait	No policy	No policy
Latvia	In addition to acquiring the skills to perform operations with rational numbers in their heads and in writing, students are expected to learn to use calculators and computers to perform operations. Students also must learn to use computers to find information.	No policy
Lithuania	No explicit policy, but students take a compulsory ICT course beginning in Grade 5. Teachers may also use computers or tablets at their discretion, but the use of calculators in primary school is not recommended.	No policy
Malta	The National Curriculum Framework emphasizes digital literacy as a cross-curricular theme. In the primary mathematics syllabus, the use of digital devices is encouraged as a learning and teaching tool.	Same as for mathematics
Montenegro	The State Education Program's goals include acquiring ICT skills, such as finding, processing, and saving information. In mathematics, it is recommended that students use calculators to check calculations and other ICT to research new ideas.	Students are encouraged to become familiar with using calculators, tablets, and computers in all subjects. Teachers may use computers in the classroom to demonstrate experiments or to enable students to practice ICT skills.
Morocco	The Ministry of Education provides digital resources for schools. More and more teachers now use computers to introduce and practice the target elements of their courses. Many schools are equipped with a multimedia room (GENIE program) where teachers can bring their students to have ICT based lessons.	Same as for mathematics
Netherlands	No policy	No policy
New Zealand	No policy. The use of technology is discussed in general terms, but not specifically within mathematics.	No policy. The use of technology is discussed in general terms, but not specifically within science.
North Macedonia	The national curriculum contains statements about the use of digital devices.	Same as for mathematics
Northern Ireland	Students should use ICT to investigate, analyze, present, and interpret information; discover patterns and relationships; and solve problems. A range of ICT, including databases and programmable devices, should be used to support and enhance students' mathematical abilities. Students should also be provided with opportunities to use Logo and spreadsheets to help develop critical thinking and problem-solving skills.	Science is described as Science and Technology. The curriculum provides levels of progression for the use of ICT. When planning topics, teachers should ensure that students are provided with opportunities to develop their skills in communication, using mathematics and ICT, and enhance their thinking skills and personal capabilities.
Norway	Using digital tools in mathematics is 1 of the 5 basic skills implemented for each subject in the curriculum. Students should be able to use digital tools for games, exploration, visualization, and publication. The skill also involves being aware of, using, and evaluating the role of digital tools for problem-solving, simulation, and modeling.	Using digital tools in science is 1 of the 5 basic skills implemented for each subject in the curriculum. Students should be able to use digital tools for exploration, measurement, visualization, simulation, registration, documentation, and publication when performing experiments and fieldwork. Digital animations, simulations, and games are aids for stimulating creativity as well as demonstrating and visualizing natural science problems and research questions. A critical assessment of internet-based information reinforces work in science.
Oman	ICT resources are suggested for teachers.	Same as for mathematics
Pakistan	No policy	No policy
Philippines	To respond to the demands of the times and to prepare and equip learners with digital literacy skills, the Department of Education has envisioned an online learning platform and the use of Open Educational Resources (OERs).	Same as for mathematics

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	Mathematics Instruction	Science Instruction
Poland	Creative problem solving with ICT is one of the main goals in the primary school curriculum. With regard to mathematics instruction, there is a statement about using calculators for more difficult calculation examples.	Although specific policies are not directly included in the core curriculum, there is an additional document that provides advice for teachers about the use of digital devices. It states that the core curriculum objectives can be achieved through activities involving computers, educational software, internet resources, interactive whiteboards, films, and games.
Portugal	The use of digital technology such as Scratch, Excel, and numerical applets, is encouraged for teaching problem solving and other learning tasks. The use of calculators is recommended only for specific situations, such as computing with large numbers and completing multistep calculations.	No policy
Qatar	The mathematics curriculum includes suggestions for teachers on the use of ICT tools and digital devices. Students should use technology to play a variety of number games to gain fluency and flexibility in reading and rounding numbers, and expressing mixed numbers as improper fractions. Students should also use ICT to work in groups to complete symmetric shapes on square grid paper, give a line of symmetry, and construct line graphs with a scale using spreadsheets.	Students should use the internet to research different topics, use data loggers to measure the temperature, and make presentations to show their results.
Russian Federation	The general recommendations for all subjects are to use ICT tools and resources to search and reproduce the necessary information and solve educational problems with simple information objects (e.g., text, drawings, available ICT resources). The program provides for the use of calculators in the study of some mathematics topics.	There are no explicit policies for science beyond the general recommendations for all subjects. These recommendations address the use of various search methods in accordance with communicative and cognitive tasks—including the ability to enter text using the keyboard, record measured values digitally, analyze images and sounds, and prepare presentations with audio, video, and graphic accompaniment—and comply with the rules of information selectivity, ethics, and etiquette.
Saudi Arabia	No policy	No policy
Serbia	The national curriculum recommends the use of ICT in instruction but does not mandate it. Students are guided in using the internet to collect relevant subject information, enrich what they are currently learning, and explore real world application.	Same as for mathematics
Singapore	Schools are guided by the Ministry of Education's Masterplan for ICT in Education in their use of digital devices to support teaching and learning in all subjects. The most recent plan aims to broaden the use of ICT for quality learning to support the curriculum. For mathematics, the curriculum framework states that for students to develop a deep understanding of mathematical concepts and make sense of their applications, they should be exposed to technological aids that help them relate abstract mathematical concepts to concrete experiences. In today's classrooms, mathematical skills also include the ability to use spreadsheets and other software to learn and do mathematics. The role of ICT in the teaching and learning of mathematics is further articulated under the Principles of Teaching in the mathematics syllabus: Teaching should connect learning to the real world, harness ICT tools, and emphasize twenty-first century competencies. Teachers should consider the affordances of ICT to help students learn. ICT tools can help students understand mathematical concepts through visualizations, simulations, and representations, as well as work collaboratively and think critically about solutions. They can also support exploration and experimentation and extend the range of problems accessible to students.	Schools are guided by the Ministry of Education's Masterplan for ICT in Education in their use of digital devices to support teaching and learning in all subjects. The most recent plan aims to broaden the use of ICT for quality learning to support the curriculum. For science, it translates into staying up to date with the changing education landscape and developments in education technology, and helping students develop twenty-first century competencies, a broad and deep foundation of learning in science, and life-long learning skills. ICT supports the inquiry process and facilitates student collaboration and self-directed learning; online collaborative tools enable students to discuss their ideas or findings and consult field experts. Internet-enabled devices can be used to facilitate data collection and analysis in situated learning. Students can also explore and visualize abstract concepts using simulations tools.
Slovak Republic	According to the State Education Program, calculators are used to perform addition and subtraction of numbers up to 10,000,000. Schools and teachers have discretion over the use of calculators in other mathematics topics. The State Education Program aims to educate students in using ICT to acquire skills in finding, processing, and saving information.	No policy
South Africa	The use of calculators is permitted for specific calculations.	No policy
Spain	The national curriculum includes the use of technology in the search for knowledge or to make calculations, solve problems, and deliver results. Students are expected to become familiar with calculators and their operating rules when solving basic problems and checking their results.	The national guidelines refer to the importance of developing digital competence (based on European key competencies) across all school subjects. For science, ICT should be used to search for and select information or to offer conclusions. There is no express reference to the use of any particular digital device.

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	Mathematics Instruction	Science Instruction
Sweden	The national curriculum states that schools are responsible for ensuring that each student can use modern technology as a tool in the search for knowledge, communication, creativity, and learning. In mathematics, students should be given opportunities to develop knowledge in using digital tools and programming to explore problems and mathematical concepts, make calculations, and present and interpret data. Students may use mental arithmetic, written methods, or digital tools to approximate natural numbers and simple numbers in decimal form. Students are also taught how to program using unambiguous, step-by-step instructions, algorithms, and visual programming environments. Construction of simple tables, diagrams, and geometric shapes should be taught with and without digital tools. The relationship between the binary number system and digital technology should also be taught.	In science, students should be given opportunities to develop different skills within various topics with the use of both digital tools and other equipment, and to look for answers by using different types of sources.
Turkey	According to the curriculum, students should learn digital competence—the safe and critical use of ICT for business, daily life, and communication. Interactive activities with appropriate ICT may be used in instruction.	Same as for mathematics
United Arab Emirates	No policy	No policy
United States	Most states do not have policies regarding computer use. However, many states have standards for technology literacy requiring computer use in mathematics instruction. Both the Common Core State Standards and Every Student Succeeds Act (ESSA; 2015) emphasize the importance of using technology in the classroom as a part of student enrichment. States are increasingly providing or enabling digital devices and digital content for students and faculty to use in school and at home. Some states have standards for the use of calculators in instruction as well as the introduction of 4-function calculators. Individual districts may give guidelines regarding calculator usage during instructional time, but there is no commonly agreed-upon policy related to calculator usage in elementary mathematics courses. Calculator usage is typically low in Grade 4; data from the 2017 National Assessment of Educational Progress (NAEP) showed that for the majority of Grade 4 students, calculators were not permitted during their mathematics lessons.	Most states do not have policies regarding computer and calculator use in science instruction. However, many states and national science standards documents include statements related to the use of technology such as computers, calculators, and other digital tools. The Next Generation Science Standards (NGSS) emphasize science practices that benefit from the use of technology, such as analyzing and interpreting data, using mathematical and computational thinking, as well as developing and using models to describe or predict science phenomena. ESSA (2015) emphasizes the importance of using technology in the classroom as a part of student enrichment, and many schools have chosen to integrate technology with their science instruction. States are increasingly providing or enabling digital devices and digital content for students and faculty to use in school and at home.
Benchmarking Participants		
Ontario, Canada	According to the Ontario Curriculum Guide, calculators and computers can be used to perform operations, make graphs, and organize and display data. Students may use digital devices to investigate number and graphing patterns, geometric relationships, and different representations to simulate situations and to extend problem solving. It is important that students learn when it is appropriate to apply mental computation, reasoning, and estimation skills to predict and check answers. Teachers can use ICT both for whole class instruction and to design programs that meet diverse student needs. ICT can be used to reduce the time spent on routine mathematical tasks; promote thinking and concept development; introduce simulations, multimedia resources, databases, and computer-assisted learning modules; and connect students to other schools, at home and abroad.	According to the Ontario Curriculum Guide, ICT provides a range of tools that can significantly extend and enrich teachers' instructional strategies and support students learning in science and technology. Computer programs can be used to help students collect, organize, and sort the data and to write, edit, and present reports on their findings. ICT also can be used to simulate investigations when field studies on a particular topic are not feasible and to connect students to other schools, at home and abroad.
Quebec, Canada	No explicit policy. The use of technological tools such as calculators or software is suggested but not mandatory.	The Science and Technology Program proposes the use of ICT in teaching science.
Moscow City, Russian Fed.	The exemplary basic educational program of general primary education is based on the use of ICT tools and resources to solve a variety of educational, cognitive, and practical problems, across all subjects. The program also provides for the use of calculators for teaching and learning some topics in mathematics.	Same as for mathematics
Madrid, Spain	Same as Spain	
Abu Dhabi, UAE	Same as United Arab Emirates	
Dubai, UAE	Same as United Arab Emirates	