

Exhibit 20: National Policies Regarding Use of Technology in Mathematics and Science Instruction at the Fourth Grade

Reported by National Research Coordinators

Country	Description of the National Policies for Use of Technology	
	Mathematics Instruction	Science Instruction
Armenia	No policy	No policy
Australia	The use of technology is encouraged but not mandated. Curriculum statements refer to "using appropriate digital technologies." The National Assessment Program in Literacy and Numeracy has a policy that calculators are not allowed in the Year 3 and 5 assessments (national assessments do not take place in Year 4).	The use of technology is encouraged but not mandated. Curriculum statements refer to "using appropriate digital technologies."
Bahrain	No policy	No policy
Belgium (Flemish)	The Flemish government has formulated attainment targets for ICT. Schools have been obliged to meet these extracurricular attainment targets since September 1, 2007.	Same
Bulgaria	There are statements about practical skills for using calculators. This will change after the new curriculum for the 2016/2017 school year is introduced for Grades 1, 5, and 8. The curriculum will include directions for 21st century skills development and use of ICT.	Same
Canada	All provincial curriculum documents contain statements/policies about the use of technology in Canada, including integrating technology into learning, instructional materials, and statements such as "Technology should never replace understanding, but should be used to enhance it."	All provincial curriculum documents contain statements/policies about the use of technology in Grade 4 science instruction, including stating required learning goals for ICT stressing that technology-based resources are essential for instruction in the science classroom, and statements such as "Technology is intended to extend our capabilities and, therefore, is one part of the teaching toolkit."
Chile	The national curriculum includes specific recommendations for integrating technology into learning, including searching for information, solving problems, presenting information in charts, and creating and delivering presentations.	Same
Chinese Taipei	After students have learned basic calculation skills, teachers can introduce technological aids into problem-solving tasks. Technology should never replace mathematics skills and the use of calculators and computers should not interfere with teaching other concepts. Calculators/computers are not allowed in high stakes assessments and, therefore, are prohibited in formal school tests. Some teachers may allow students to use calculators/computers on quizzes. In 2001, the Ministry of Education announced the Blueprint for Information Education for Primary and Secondary Schools to encourage the application of information technology in subject area learning for elementary and secondary school students.	Teachers should teach science with various media and resources, including the use of computers and Internet to engage students in using technology to search for information. In 2001, the Ministry of Education announced the Blueprint for Information Education for Primary and Secondary Schools to encourage the application of information technology in subject area learning for elementary and secondary school students.
Croatia	Students should learn to use pocket calculators and appropriate educational computer programs.	No policy
Cyprus	Technology should be used when it adds value to the conceptual development of mathematical ideas.	It is a provision of the national curriculum to foster multiple key competencies, including the "fluent, valid, and considerate use of ICT."
Czech Republic	No policy	No policy
Denmark	Information technologies must be integrated in daily teaching. A significant investment has been made in the acquisition of digital learning materials and research into ICT-based learning methods. For example, in mathematics, digital tools are generally used to solve problems and to find information. As a part of the problem-solving curriculum, students in Grades 4–6 learn to select and use the best digital tool to develop answers, as well as use dynamic geometry programs and computer algebra systems.	Information technologies must be integrated in daily teaching. A significant investment has been made in the acquisition of digital learning materials and research into ICT-based learning methods. ICT and media are integrated in science together with other tools and sources of information as developmentally appropriate for students in Grades 1–6. Digital tools are especially important in science (e.g., digital maps, digital measuring tools, digital references, information systems, and digital representations, such as animations and simulations illustrating processes in nature and in society).
England	Calculators should not be used as a substitute for good written and mental arithmetic. They should therefore only 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. In both primary and secondary schools, teachers should use their judgement about when ICT tools should be used.	No policy
Finland	The mathematics section of the National Core Curriculum articulates as a general goal that "information and communication technology are to be used to support the pupil's learning process."	The curriculum states, generally, that the learning environment must be equipped so as to support the pupil's development into a member of today's information society, and provide opportunities for the use of computers, other media technology, and, as possibilities allow, data networks.
France	During Cycle 3 (which includes Grade 4), the use of ICT has to become habitual in the framework of the "B2i," Brevet informatique et Internet (Certificate for information technology and Internet). The "B2i" certificate must be obtained at three levels: the end of primary school (Grade 5), the end of lower secondary education (Grade 9), and the end of secondary schooling (Grade 12). The Grade 4 mathematics curriculum includes a section on numbers and calculation that indicates that for calculation with a calculator, there should be wise use of a calculator depending on the computational complexity faced by students.	During Cycle 3 (which includes Grade 4), the use of ICT has to become habitual in the framework of the "B2i," Brevet informatique et Internet (Certificate for information technology and Internet). The "B2i" certificate must be obtained at three levels: the end of primary school (Grade 5), the end of lower secondary education (Grade 9) and the end of secondary schooling (Grade 12). This statement is not specific to science or mathematics, but to all school subjects.

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	Mathematics Instruction	Science Instruction
Georgia	For the last few years, a program called "One netbook per child" has been underway in Georgia, through which each first grade student receives a netbook as a gift. Some educational resources in electronic format have been created for netbooks (e.g., interactive teaching materials, computer games, etc.), that are aimed at helping pupils to better understand the core ideas and concepts, enable them to learn with discovery, and to make the teaching-learning process visible. At this stage (Grades 1–6), ICT is integrated in all subject areas. Use of ICT in the teaching-learning process in Grades 1–4 is highly encouraged but is not mandatory. Consequently, according to the educational aims at the end of this stage (Grade 4), students are not required to demonstrate their proficiency in use of ICT. Lastly, teacher trainings in effective use of ICT in the teacher education process have been scaled up to include all primary school teachers (including math and sciences teachers).	Same
Germany	Varies by state. For example, in the state of North Rhine–Westphalia, the following refer to all primary school curricula, including mathematics instruction: 1) ICT together with traditional media are both learning aids and topics of instruction; 2) Primary school instruction orients students to important sources of information and introduces them to the meaningful use of ICT; 3) Systematic work with media helps pupils develop media literacy.	Same
Hong Kong SAR	The use of calculators aims to facilitate learning of mathematics rather than replace mental arithmetic and written calculation. Students can use calculators to explore number patterns, construct concepts, and check different methods and results of problem solving. With the help of calculators, teachers can strengthen students' abilities in mental arithmetic and estimation, and judge the reasonableness of the results of calculation. Students should be guided to recognize the functions and limitations of calculators, so as to strengthen their abilities in exploring and solving problems.	In the science curriculum, computer use is included under "Global Understanding and the Information Era."
Hungary	Technology is used in instruction to develop cognitive processes.	No policy
Indonesia	Computer use is recommended, but not mandatory, to be used to enhance instruction.	Same
Iran, Islamic Rep. of	Calculator and computer use are taught and recommended, but not mandated. Calculators and computers are permitted during examinations at the teacher's discretion.	Same
Ireland	The mathematics curriculum includes statements on the use of ICT in primary school. For example, mathematics education should enable children to think and communicate quantitatively and spatially, to solve problems, recognize situations in which mathematics can be applied, and to use appropriate technology to support such applications. The curriculum includes the use of calculators from Grade 4 onwards to enhance students' understanding of mathematics and help develop their problem-solving skills. However, the curriculum stipulates that students need a sound understanding of numbers to make judgments about when it is appropriate to estimate, to calculate mentally, to make a calculation on paper, or to use a calculator for an exact result. Standardized tests for Grade 4 have specific directions for when a calculator can and cannot be used.	The science curriculum includes statements on the use of ICT in science instruction in primary school, noting that students' investigations and explorations can be enhanced through the use of ICT. For example, ICT can help students record and analyze information, simulate investigations and perform tests that support scientific topics, communicate scientific information and findings, work collaboratively on science projects with students in other schools, and access and use a range of scientific and technological information. Computer-based simulation may be particularly helpful when students are conducting investigations difficult to organize in real-life contexts.
Italy	The latest national guidelines often refer to the importance of developing digital competencies (based on European key competencies) across all school subjects. Beginning in the 2015–2016 school year the Piano Nazionale Scuola Digitale (National Plan for Digital School) was implemented, providing a strategy for digital innovation for the whole school system.	Same
Japan	It is necessary to appropriately use computers to enrich students' sense of numbers, quantities, and geometrical figures, as well as their ability to represent data through tables and graphs.	Computers and audio-visual aids should be used appropriately in giving instructions on observations, experiments, cultivation, raising animals, and making learning materials.
Jordan	Phases 1 and 2 of the Education Reform for Knowledge Economy Project emphasizes the use of ICT in teaching and learning processes.	Same
Kazakhstan	The mathematics curriculum for Grades 1–4 indicates that students should be able to carry out calculations with numbers up to one billion using calculators.	No policy

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	Mathematics Instruction	Science Instruction
Korea, Rep. of	The Teaching Methods Curriculum states that a diverse and appropriate set of educational materials should be employed by teachers to promote the effective learning of mathematics. Tools such as calculators, computers, and educational software help students perform complex computations when the aim is not to nurture students' computational skills. These tools can help to develop a deeper understanding of mathematical concepts, principles, and laws, and enhance problem solving-skills. Depending on the content and methods being evaluated, evaluation of learning in mathematics should provide students with opportunities to use these tools.	The curriculum states that science instruction should "give priority to hands-on activities, and utilize appropriate computer-based labs, the Internet, and multimedia resources."
Kuwait	No policy, but it is customary for schools to allow calculator use in simple mathematics problems or for verification of answers. Calculators are not allowed during tests. The public and private Arabic schools do not include formal computer instruction in the curriculum, but there are some integrated lessons taught by ICT teachers to train students on how to use and apply mathematics using computers.	No policy, but it is customary for schools to allow calculator use in simple mathematics problems, or for verification of answers and scientific rules in the classroom. Calculators are not allowed during tests.
Lithuania	No policy, but a compulsory ICT course starts from Grade 5. In primary schools, teachers may use computers (or tablets) at their discretion. Use of calculators in primary schools is not recommended.	No policy
Morocco	ICT is incorporated into instruction according to pedagogic guidelines and ministerial circulars.	Same
Netherlands	No policy	No policy
New Zealand	No policy, but the use of technology is addressed generally within mathematics: "Schools should explore not only how ICT can supplement traditional ways of teaching, but also how it can open up new and different ways of learning."	Same
Northern Ireland	In Key Stage 1 (ages 6–8), "Children should be given opportunities to use ICT to support and enhance their mathematics. They should be given worthwhile experiences in a range of ICT including graphing packages, databases, programmable devices and calculators." In Key Stage 2 (ages 8–11), "Children should use ICT to investigate, analyze, present and interpret information, to discover patterns and relationships and to solve problems. A range of ICT should be used to support and enhance mathematics, including databases and spreadsheets." Statutory Rule 2007/45 requires pupils in Years 4–7 (ages 7–11) to be assessed in Numeracy in the autumn term using a computer-based assessment method. The results of these assessments are not collated centrally but are used by schools to inform learning and teaching. Outcomes are shared with parents. These assessments have been voluntary since 2012.	Science is described as Science and Technology in Northern Ireland. In addition there are Levels of Progression for the use of ICT across the curriculum, including science. The Northern Ireland Curriculum for primary school states: "When planning topics, teachers should ensure that opportunities are provided for children to develop their skills in Communication, Using Mathematics, Using ICT and their Thinking Skills and Personal Capabilities."
Norway	Using digital tools in mathematics involves using such tools for games, exploration, visualization, and publication. It also involves being aware of, using, and evaluating the role of digital tools for problem solving, simulation, and modeling. It also is important to find information, analyze, process, and present data with appropriate tools, and to be critical of sources, analyses, and results.	Digital tools are used in science for exploration, measurement, visualization, simulation, registration, documentation, and publication when performing experiments and fieldwork. Digital animations, simulations, and games are good aids for stimulating creativity, and demonstrating and visualizing natural science problems and research questions. Critical assessment of Internet-based information reinforces the work in this subject. Digital communication systems make it possible to discuss natural science problems and research questions.
Oman	No policy	No policy
Poland	No policy	No policy
Portugal	Simple calculators are suggested as an aid in Grade 4 for calculations with large numbers and/or for calculations requiring a large number of steps.	No policy
Qatar	The Electronic Learning Program is an initiative that has been launched by the Ministry of Education and Higher Education to develop the educational process and to provide e-services based on integrated digital technology, to enhance the efforts of the government of Qatar in improving the quality of teaching and learning.	Same
Russian Federation	The standards require three levels of ICT use in general education—ICT in the curriculum and school resources, ICT in real teacher practice, and student achievement in ICT use in learning. Calculators are used in Grade 4 mathematics instruction together with other methods to check the validity and correctness of calculations. The use of electronic textbooks is being explored and a new program is being introduced to teach ICT competencies in the context of school subjects, including mathematics.	The standards require three levels of ICT use in general education—ICT in the curriculum and school resources, ICT in real teacher practice, and student achievement in ICT use in learning.

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Country	Description of the National Policies for Use of Technology	
	Mathematics Instruction	Science Instruction
Saudi Arabia	Teachers are required to use the most modern technology available.	Same
Serbia	No policy, however, for the first cycle of education, there is an optional subject, "From Toys to Computers," which provides training for students to use computers in all subjects.	Same
Singapore	Teaching should connect learning to the real world, harness ICT tools and emphasize 21st 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. They can also support exploration and experimentation and extend the range of problems accessible to students. The ability to use ICT tools is part of the 21st century competencies. It is also important to design learning in ways that promote the development of other 21st century competencies such as working collaboratively and thinking critically about the mathematical solution.	In science, ICT supports the inquiry process and also facilitates student collaboration and self-directed learning. For example, online collaborative tools allow students to share and discuss their ideas or findings within the school, and also extend their learning through consulting field experts. Internet-enabled devices facilitate data collection and analysis in situated learning. Students also explore and visualize abstract concepts using simulation tools.
Slovak Republic	The use of calculators for addition and subtraction of numbers up to 10,000 is defined in the State Education Program Mathematics Performance Standard under the theme Numbers, Variables, Computations with Numbers (Numeracy). The use of calculators is under the discretion of the teacher or school, including their use on examinations. Acquiring skills related to the usage of ICT is one of the goals of the State Education Program. These ICT skills include finding, processing, and saving information.	No policy
Slovenia	It is recommended to use ICT as much as possible to help with calculations and researching new ideas. Examples of ICT use include working with different types of calculators, spreadsheets, the Internet, and specific software to present functions or simulate geometry.	The general use of computers is expected to be taught in subjects other than science. The use of computers should be taught in computer laboratory, but teachers may decide to use computers in the classroom for demonstrations or to have students practice their skills.
South Africa	No policy	No policy
Spain	Students are encouraged to become familiar with using calculators, tablets, and computers to generate series and to compose and break down numbers. They may also be used to help solve complex problems. Some items in tests and examinations require the use of technological aids.	Same
Sweden	The national curriculum states that the school is responsible for ensuring that each student can use modern technology as a tool in the search for knowledge, communication, creativity, and learning. Specifically for mathematics, one of the aims described in the syllabus is that students should be given opportunities to develop knowledge in using digital technology to explore problems, make calculations, and to present and interpret data. Syllabi also prescribe core content, and for Grades 1–6, the only explicit reference to technology is the use of calculators in numeric calculations. Students should also learn about tables, diagrams, and graphs, and how they can be interpreted and used to describe the results of the students' own and others' investigations using digital tools.	The national curriculum states that the school is responsible for ensuring that each student who completes compulsory school can use modern technology as a tool in the search for knowledge, communication, creativity, and learning. There are no specifics about this for science.
Turkey	Access to technology is increasing rapidly and is providing new opportunities for teaching meaningful mathematics. Educational software is increasingly being integrated into instruction.	Incorporating ICT into science instruction provides opportunities for developing and applying scientific knowledge that can simplify science learning. ICT can support student participation in research and learning by facilitating obtaining, analyzing, and presenting data.
United Arab Emirates	No policy, but there are tips regarding online materials in teachers guides.	No policy
United States	Varies by state, and many states have standards for technology literacy requiring computer use in mathematics instruction. Many school districts and schools have chosen to integrate technology (computers, tablets, interactive whiteboards) with their mathematics instruction. States are increasingly providing or enabling digital devices and digital content for students and faculty to use in school and at home. Some states also have standards for use of calculators in instruction. Most states include calculator use in the fourth grade curriculum. In general, it is common for students to progress from no calculators, to four-function calculators, to scientific calculators, to graphing calculators as they advance through the grade levels. Individual districts may give guidelines regarding calculator usage during instructional time.	Varies by state, and many states have standards related to the use of technology (computers, calculators, and other scientific laboratory equipment) to collect, record and analyze data for conducting scientific investigations. For example, some science standards and local curricula include mastery of spreadsheet or database software as necessary for data analysis. Many school districts and schools have chosen to integrate technology (computers, tablets, interactive whiteboards) 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.

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Country	Description of the National Policies for Use of Technology	
	Mathematics Instruction	Science Instruction
Benchmarking Participants—Responses Pertain to Benchmarking Provinces/Emirates/States		
Buenos Aires, Argentina	The curriculum proposes the use of calculators to solve problems.	No policy
Ontario, Canada	Although students must develop basic operational skills in mathematics, calculators and computers can help them extend their capacity to investigate and analyze mathematical concepts and reduce the time they might otherwise spend on purely mechanical activities. Students can use calculators or computers to perform operations, make graphs, and organize and display data that are lengthier and more complex than those that might be addressed using only pencil-and-paper. Students can also use calculators and computers in various ways to investigate number and graphing patterns, geometric relationships, and different representations to simulate situations and to extend problem solving. When students use calculators and computers in mathematics, they need to know when it is appropriate to apply their mental computation, reasoning, and estimation skills to predict and check answers.	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 help students collect, organize, and sort the data they gather and to write, edit, and present reports on their findings.
Quebec, Canada	The use of information and communications technologies is compulsory, though activities involving ICT are included at the teacher's discretion.	Suggestions for using ICT are provided in the provincial curriculum document and include: using electronic mail to exchange information; using the Internet to access websites related to science and technology; using CD-ROMs to gather information on a given topic; organizing and presenting data using different types of software; using simulation or graphics software; producing a graphical representation of data; conducting experiments with the help of a computer; and robotics and automation.
Abu Dhabi, UAE	No policy	No policy
Dubai, UAE	No policy, but there are tips regarding how to use online materials in teacher guides.	Same
Florida, US	By 2015–2016, each district in Florida is required to use at least 50 percent of the annual allocation for the purchase of digital or electronic instructional materials included on the list of state-adopted instructional materials. Student use of calculators is not permitted for paper-based or computer-based Grade 4 mathematics tests.	Same

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