

## NORWAY [3] - 2012

### SCIENCE FOR THE FUTURE

#### A. BASIC INFORMATION

<b>Country:</b>	Norway
<b>Title of initiative:</b>	[NO] <i>Realfag for framtida. Strategi for styrking av realfagene 2010-2014</i> [EN] Science for the future: Strategy for strengthening mathematics, science and technology (MST) 2010 –2014
<b>Coordinator/ Organization:</b>	Directorate of Education
<b>Key competences addressed:</b>	[NO] <i>Å kunne regne som grunnleggende ferdighet;</i> [EN] Mathematical competence and basic competences in science and technology
<b>Type of initiative and channels used for implementation</b> (e.g. curriculum reform introduced through legislation etc.)	National initiative, strategy defined by the Ministry of Education and Research
<b>Partners:</b>	<ul style="list-style-type: none"> <li>· National Education Authorities · Organisation of Municipalities</li> <li>· Organisations of Employers in Trade and Industry · Trade Unions</li> </ul>
<b>Scope:</b> (student/teacher/school level; local/regional/national)	Student, teacher, school level Local, regional, national
<b>Learning context:</b> (formal or non-formal)	Formal
<b>School education level/s:</b> (primary, lower secondary, upper secondary)	Primary, lower secondary, upper secondary
<b>Target groups:</b>	Students and teachers
<b>Time frame:</b> (start and end date)	2010-2014
<b>Relevant links:</b>	<ul style="list-style-type: none"> <li>· Action Plan: Strategy for Strengthening Mathematics, Science and Technology: <a href="http://www.regjeringen.no/en/dep/kd/documents/reports-and-actionplans/Actionplans/2010/science-for-the-future.html?id=593791">http://www.regjeringen.no/en/dep/kd/documents/reports-and-actionplans/Actionplans/2010/science-for-the-future.html?id=593791</a></li> <li>· National Centre for Mathematics Education: <a href="http://www.matematikk-senteret.no">www.matematikk-senteret.no</a></li> <li>· New Possibilities project: <a href="http://www.regjeringen.no/upload/KD/Kampanjer/NyGiv/NyGiv5.pdf">http://www.regjeringen.no/upload/KD/Kampanjer/NyGiv/NyGiv5.pdf</a></li> </ul>

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## B. SUMMARY

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**Science for the future: Strategy for strengthening mathematics, science and technology (MST) 2010 –2014.**

In its 2010 strategy document, the Ministry of Education and Research stated that high competence in Mathematics, Science and Technology (MST) is a prerequisite to meet the great challenges of today and tomorrow. With policy concerns of decreasing numbers of MST graduates and skills shortages in these areas, the strategy aims to increase the number of MST students by 15 %. Norway needs a sufficient number of people with insight into MST in order to understand these challenges and to act accordingly. As a national strategy this initiative involves many partners and targets teachers and students at all levels of education, from kindergarten to higher education.

The initiative is still halfway through the implementation period (2010-2014) and no evaluation of its impact is available at present.

## C. IN DEPTH INFORMATION

### Rationale/contextual background/motivation for introducing the initiative/reform:

· The Ministry of Education and Research, in its strategy document from 2010, stated that high competence in Mathematics, Science and Technology (MST) is a prerequisite in order to meet the great challenges of today and tomorrow. Norway needs a sufficient number of people with insight into MST in order to understand these challenges and to act accordingly. Many exciting opportunities exist and are ready to be discovered by curious scientists. Knowledge in science and technology provides much of the basis for productive work and welfare in Norway. This expertise creates jobs and provides important contributions to health and welfare and in the future MST will have an even greater impact. The education sector and trade and industry have for several years worked in collaboration in order to enhance subjects related to science and technology in education. The current strategy Science for the Future 2010-2014 has been developed in collaboration with the education sector, the research sector and trade and industry. All involved have a different role to play but they also have a mutual commitment to supporting a new initiative with a common goal and to working harder to achieve this. Through cooperation in the National Forum for Science, the partners contribute to this joint effort and to forming a stronger commitment from all stakeholders in order to strengthen mathematics, science and technology in Norway.

This strategy is the successor of the strategies Mathematics, Science and Technology – naturally... 2002-2007 and A Joint Promotion of Mathematics, Science and Technology (MST) 2006-2009. While the 2006-2009 strategy has not yet been evaluated, A study by Rambøll Management criticised the 2002-2007 strategy for having greater a focus on activities than on measurable results. As was also observed, a lack of documentation of the results made it difficult to see the connection between actions and their impact on education. Evaluation of the strategy for 2002-2007 pointed out that for future work it would be important to:

- ensure the project is established locally with measurable objectives and regular reporting on results
- ensure clear responsibilities among all actors with regard to implementation, follow up and dissemination
- strengthen the competence of teachers in primary and lower secondary schools
- strengthen teachers' didactic skills to illustrate the usefulness of science both in society and in the classroom in order to create more positive attitudes toward science among the pupils

### Objectives:

The National Forum for Mathematics, Science and Technology brings together the main organisations and participants in education and working life in Norway. The Forum is established as an advisory body for the Ministry of Education and Research regarding all matters related to the status and development of MST. The National Forum for Science aims to implement measures to establish high-quality science education at all levels and to improve recruitment to education and careers in science.

**Dimensions targeted by the initiative/reform** (e.g. student curriculum, assessment, initial/in-service teacher education, school autonomy etc.):

MST as a compulsory subject for all students until the end of year 10 and afterwards for vocational education and training (VET) until year 11 and for programmes in general education until year 12.

**Overall approach** (e.g. holistic – existence of an overarching strategy, or targeted approach focusing on a specific dimension etc.):

This initiative represents an overarching strategy towards mathematical competence and basic competences in science and technology.

**Detailed explanation of the key competence/s concerned:**

Emphasis on basic skills in Mathematics, Science and Technology from an early level of schooling, and on more complex skills at a later stage of education.

**Specific subjects concerned or cross-curricular approach:**

Science, technology, engineering, and mathematics (STEM).

**How the initiative/reform is being implemented** (e.g. process followed, political commitment, consultation with stakeholders and their respective roles, incentives for stakeholders, dedicated funding, teaching material, definition of goals and standards, assessment and evaluation mechanisms, impact on teacher training/professional development and school practices/leadership, scaling-up approach, based on research/evidence? etc.):

- The main elements of the national policy to reduce low achievement are based on early intervention, national tests and mapping tests, as well as the integration of basic mathematics skills in all subject curricula.
- The school system is based on what is called “adapted education”. Individual pupils are taught alongside their peers, with the support of learning aids, assistive technology, human assistants or extra teaching resources necessary to receive an education within the framework of ordinary tuition and the school budget. Pupils who either do not or are unable to benefit satisfactorily from mainstream tuition have the right to special education.
- The national strategy, Science for the future: Strategy for strengthening mathematics, science and technology (MST) 2010 –2014 and the National Centre for Mathematics Education are important agents in promoting mathematics education and nationally defined numerical targets have been drawn up in this area.
- The strategy can be accessed here: <http://www.regjeringen.no/en/dep/kd/documents/reports-and-actionplans/Actionplans/2010/science-for-the-future.html?id=593791>,

- The national quality assessment system (NKVS) is an important tool for evaluating the education system and schools in Norway. Important elements of the NKVS are national tests as well as a web-based portal (Skoleporten – School Portal), where information on learning outcomes, learning environments is given along with resources and details of pass rates in upper secondary school, training opportunities and information about schools. Data from the system are used in different evaluation activities, such as analysis by the Norwegian Directorate for Education and Training identifying 40 municipalities with poor results in national reading and numeracy tests. Professional guidance and training of teachers at schools in these municipalities has been offered from the state.
- The National Centre for Mathematics Education ([www.matematikkcenteret.no](http://www.matematikkcenteret.no)) plays an important role in developing mathematics education and reducing gaps in numeracy skills. The Centre's target groups are teachers of mathematics and students. The Centre is involved in following up New Possibilities (NyGIV), a national project to increase the successful completion of upper secondary education and training from 70 to 75 per cent. There is a close monitoring of pupils with the poorest results in grade 10. Courses are offered for teachers across the country on how to develop pupils' basic skills in reading, writing and numeracy. Teacher networks have been established to orient classroom practices towards more practical methods in the common core subjects of Norwegian, English and Maths. <http://www.regjeringen.no/upload/KD/Kampanjer/NyGiv/NyGiv5.pdf>
- KIM (Quality in mathematics education) is a web-based set of tests for primary and secondary school students. KIM is based on a diagnostic teaching of mathematics, using information from students' incorrect answers.

## Present stage/phase of implementation:

The initiative is being implemented through targeted national centres for Mathematics and Science.

## Pedagogical issues (issues related to how key competences are being taught to students and how are teachers being prepared to teach them):

With policy concerns regarding decreasing numbers of MST graduates and skills shortages in these areas, the 'Strategy for Strengthening MST 2010-2014' aims to increase the number of MST students by 15 %. The National Centre for Mathematics Education plays an important role in promoting mathematics education.

A number of measures for strengthening students' skills before they enter higher education have been adopted and the National Centre for Recruitment in MST plays a vital role in the implementation of these measures.

The Ministry of Education and Research has established a working group to look into how mathematics can be made more relevant and engaging for students at all levels of education. In addition, the National Centre for Recruitment in MST has initiated the establishment of a national agency to promote MST role models in the form of ambassadors from a variety of educational pathways and professions. Lower and upper secondary schools can book visits from role models and may also visit them at their workplace.

## What works well (to identify enablers):

As a result efforts over recent years to improve the quality of primary and secondary education in general and of science in particular, there are indications that the downward trend is about to turn, as shown by the TIMSS (Trends in International Mathematics and Science Study) 2007 shows. Pupils in grade 4 have shown significant progress both in Mathematics and in Natural Science compared to 2003, while there is some progress in grade 8 Mathematics, but a decline in Natural Science. The TIMSS 2007 Report gives further advice concerning what can result in good learning as well as what does not. It points out that Norwegian schools only follow up and give feedback on the pupils' work to a very low degree. The report also shows that students in Norwegian schools do a great deal of individual work. Norwegian students perform poorer than students in countries with which comparisons are naturally made. Many students are below the minimum level of competence in MST, and almost none are at the highest level. Moreover, Norwegian students in particular lack skills in formal mathematics and in physics. Therefore it still is important to improve education in MST.

## Challenges and how these are being addressed (to identify obstacles and solutions):

- Many challenges in today's society are of a technological or scientific nature and this will increasingly be the case. The world of work requires a high level of understanding of Mathematics and Technology in order to solve tasks. According to projections from Statistics Norway, the demand from businesses for candidates with a degree in science and technology will increase over the coming years. Despite the measures taken, Norwegian pupils still perform considerably below the international average. A lack of recruitment to science is a common challenge for countries in the OECD area and is described by many as a phenomenon of affluence. Nevertheless the problem seems to be greater in Norway than in other countries.
- Mathematics does not have an equivalent main subject area. However, varied ways of working are a professional responsibility for individual schools. Some teachers and schools do not have the necessary competence to make the teaching of sciences sufficiently practical. The National Centre for Mathematics in Education has developed practical teaching materials that are used by a number of schools. The National Centre for Science Education provides extensive information for schools on the importance of experimental work in science and on the necessary equipment to achieve this. Agreements for cooperation with local companies through the programme Trade and Industry in Schools have contributed to more practical knowledge of how MST can be used.
- Regional Science Centres have been established to create an interest in MST and in 2009 20.3 million Norwegian kroner was allocated to these centres by the Ministry allocated. Their aims are to strengthen the awareness and the usefulness of science in society and in the workplace. The Science Centres are popular science adventure and learning centres for MST, targeting pupils, students and the public.

**Monitoring & evaluation so far/planned, and which methods are being used** (e.g. internal/external quality assurance, inspection, national assessments, international tests, self-evaluation, formative or summative evaluations):

There are eight national tests or exams in mathematics:

- National tests (*Nasjonale prøver*): Three tests in numeracy, in grades 5, 8 and 9, carried out for monitoring purposes. Compulsory for all pupils in those grade levels.
- Examinations (*Eksamen*): The examination is conducted in grade 10 for the purpose of taking decisions about the educational career of pupils (certification) and is compulsory for all pupils in that grade level. Students are selected to sit for an examination in either mathematics, Norwegian or Sami, or English.
- Diagnostic tests (*Kartleggingsprøver*): Three tests in mathematics, in grades 1, 2 and 3, conducted for the purpose of identifying individual learning needs. The test in grade 2 is compulsory for all pupils but optional at the other two grade levels.
- Diagnostic test (*Obligatorisk kartleggingsprøve*): One test in numeracy, in grade 11 (Vg1), conducted for the purpose of identifying individual learning needs. The test is compulsory for all pupils in this grade level.

Maths is also included in school leaving examinations at the end of upper-secondary education as an elective subject.

**Impact** (e.g. any planned impact assessment?):

See above ('Monitoring & evaluation')

**Communication of the initiative/dissemination of outputs and activities:**

Mainly through national strategy documents.

**Next steps/follow-up:**

The national centres for education in Mathematics and in Science have a mission to provide excellence in MST education throughout the whole educational pathway from kindergarten to adult education. The centres develop and distribute experiences regarding working methods and teaching material in MST that have proven effective, in line with the competence objectives of the Knowledge Promotion. The centres are central in providing schools and individual teachers with knowledge of and practical help regarding teaching methods that provide high quality education. In order to encourage more teachers to gain high competence in science subjects an arrangement was introduced in 2009 giving students completing teacher training in science partial exemption from tuition costs. This applies to students taking an integrated masters programme in teacher education with science subjects, a two-year master programme in didactics for teachers in science or a one-year practical-pedagogical training for students who have completed 3-years of education in engineering or a graduate degree in MST subjects.

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