D2.1 REPORT ON COMPARATIVE DATA ON THE LANDSCAPE FOR LOW ACHIEVERS IN MATHEMATICS AND SCIENCE IN THE PARTNER COUNTRIES

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Deliverable D2.1: General introduction

This report aims at highlighting the differences in the way that systemic structures influence the trajectories of lower achieving students within the FaSMEd participating countries. In the following sections, the different interpretations of low achievement in the participating countries will be analysed, with a specific focus on the assessment tools used to identify low achievers (section D2.1.1). Moreover, the typical pathways for low achievers through the different school systems will be identified (section D2.1.2), together with the other educational opportunities available for these students (section D2.1.3). The fourth section (D2.1.4) will be devoted to the analysis of the main outcomes of the possible trajectories for low achievers in the participating countries.

The collection of data about the approach to low achievers in the participating countries has been initially developed through a questionnaire meant to collect data and information from each country about the approach to low achievers and related educative approaches and tools.

The questions posed to the partners were:

- How is 'low achievement in mathematics and science' interpreted in your country? How are low achievers considered in teaching practices in your country? How are they helped?
- How are these students identified and at what age? What are the consequent interventions?
- Are there any tools and technology available to support teaching and assessment in mathematics and science?
- Have there been any local, regional or National studies or initiatives in your country concerning low achievement in mathematics and /or science?
- What is the general view of formative assessment in your country?
- Have there been any local, regional or National studies or initiatives in your country concerning formative assessment with and without technological tools?

The data collected through the questionnaire have been integrated with other data, derived from different sources:

(a) the Eurydice reports "*National Testing of Pupils in Europe: Objectives, Organisation and Use of Results*" (2009), "*Mathematics Education in Europe: Common Challenges and National policies*" (2011), "*Science Education in Europe: National Policies, Practices and Research*" (2011), "*Developing Key Competences at School in Europe: Challenges and Opportunities for Policy*" (2012), "*Education and Training in Europe 2020: Responses from the EU Member States*" (2013);

(b) the descriptions of European education systems provided by the European Encyclopaedia on National Education Systems (Eurypedia);

(c) the "Reviews of Evaluation and Assessment in Education" commissioned by OECD, available for Norway (Nusche et al., 2011) and Netherlands (Nusche et al., 2014) and the Country Background Reports connected to the "Review on Evaluation and Assessment Frameworks for Improving School Outcomes", available for Norway (Norwegian Directorate for Education and Training, 2011), Ireland (Department of Education and Skills, 2012) and France (Direction de l'Évaluation, de la Prospective et de la Performance du Ministère de l'Éducation nationale, 2012);

(d) the surveys commissioned by OECD "*Against the Odds: Disadvantaged Students Who Succeed in School*" (2011), "*Synergies for Better Learning. An International perspective on evaluation and assessment*" (2013), "*PISA 2012 Results: What Students Know and Can Do. Student Performance in Mathematics, Reading and Science, Volume I*" (2014);

(e) the report "*European mapping of initiatives on the development of key competences*", published by European Schoolnet (2013).

D2.1.1 Identification of low achievers

Introduction to this theme

As reported in the 2012 Eurydice report "Developing Key Competences at School in Europe: Challenges and Opportunities for Policy", low achievement among students is a concern for many European countries.

Since the year 2003 for mathematics and 2006 for science, the international comparative PISA study uses a scale of six proficiency levels to evaluate the collected data. The proficiency levels represent groups of tasks of ascending difficulty (with level 6 being the highest and level 1 being the lowest). Each one is related to a specific set of mathematical/scientific competencies that students need in order to attain that level. Hence, the levels characterize the development of scientific/mathematical literacy and can be used to specify a student's achievement qualitatively. In order for a student to attain a certain level of proficiency, (s)he must be able to solve at least 50% of the tasks belonging to this level. Students, who only reach the first proficiency level or even remain below it, are identified as a *potential risk group*. It is, in fact, argued that these teenagers will face significant difficulties in the transition from education to work.

In mathematics, being counted as part of the risk group belonging to level 1 means that a student can: (a) answer questions involving familiar contexts where all relevant information is present and the questions are clearly defined; (b) identify information and carry out routine procedures according to direct instructions in explicit situations; (c) perform actions that are almost always obvious and follow immediately from the given stimuli. Students below Level 1 may be able to perform very direct and straightforward mathematical tasks, so that the selection criteria are clear and the relationship between the chart and the aspects of the context depicted are evident, and performing arithmetic calculations with whole numbers by following clear and well-defined instructions.

In science, belonging to the proficiency level 1 means that students have such limited scientific knowledge that it can only be applied to a few, familiar situations, therefore they can only present scientific explanations that are obvious and follow explicitly from given evidence. Students that score below Level 1 usually do not succeed at the most basic levels of science that PISA measures. Such students are considered to be more likely to have serious difficulties in using science to benefit from further education and learning opportunities and in participating in life situations related to science and technology.

In the OECD report "PISA 2012 Results: What Students Know and Can Do. Student Performance in Mathematics, Reading and Science, Volume I" (2014) it is stated that, as regards Mathematics, all PISA participating countries show students at Level 1 or below; but the largest proportions of students who attain only these levels are found in the lowest-performing countries.

As regards Science, it is stated that, across OECD countries, 18% of students perform at or below Level 1.

In the following paragraphs the interpretation of low achievement (when possible in mathematics and science) and the tools used to identify low achievers in each participating country are introduced.

Interpretation of low achievement in England and identification of low achievers

The government administration established by the election of 2010 has encouraged the establishment of a wide range of types of school and a diverse range of approaches to education in England, the other countries in the UK have their own arrangements. In England, the newly introduced national curriculum from September 2014 can only be expected to increase this diversity, particularly in assessment, with schools being encouraged to develop their own approaches. Hence it is difficult to make any generalisations about the identification, support and trajectory for low attaining learners for the future.

Achievement in both mathematics and science in England is dominated by a discourse of 'ability', which largely determines the trajectory of children's attainment through a system of educational 'triage' (Marks, 2014). In England, the challenge in both mathematics and science education is that: "a pupil's prior attainment affects the quality of teaching received, and hence the quality of his/her learning, progress and subsequent attainment" (Ofsted, 2012).

Following the introduction of a 'National Curriculum' for England, Wales and Northern Ireland in 1989, issues of attainment have been dominated by a system of national tests (see NAHT 2014 for a useful history of national assessment in England).

In England (arrangements are different in the other countries in the UK) from 1989 until this year (2014), learners' progress has been measured through national tests at the ages of 7, 11, 14 and 16. These ages mark the end of the 'stages' of education called 'Key Stage', so 7 is the end of Key Stage 1 and so on. Key stage 3 tests were abandoned in 2008 following a range of problems and replaced by teacher assessments, although 'optional' tests were available until this year. These tests were statutory (established in law) and all state schools were required to carry them out, although parents could withdraw their children if they wished.

For the past 25 years, therefore, attainment in mathematics and science up to the age of 16 has been measured by a national curriculum, which defined attainment targets in levels with targets set for expected performance at 'key stages' in children's schooling. The results of the tests at ages 7, 11 and assessments at 14 were reported as 'levels' with each level corresponding to a set of criteria. At 16 the results are reported as a General Certificate of Education grade A* - G (with A* the highest). In mathematics the levels were originally established on the basis of research (Hart, 2004). The original intention was to establish a 'criterion referenced' summative assessment system. Subsequent administrations also established 'expected' levels of attainment broadly based on Hart's (1985) research.

The 'expected' levels were originally based on the mean average attainment levels – the move from 'average' to 'expected' provides an interesting illustration of the innumeracy of successive secretaries of state. Later governments announced targets for schools, setting out the percentage of pupils expected to achieve these target levels. Pupils not achieving the targets were thus regarded as being '*low achievers*'. League tables of schools were also published revealing their performance relative to these expected levels of attainment.

However, from this year (2014) this system has been changed, with levels being abolished. The new arrangements set the expectations that all children will be taught and achieve the 'attainment targets' which are contained in the programmes of study. Schools are being invited to invent their own methods of assessment in relation to these new arrangements. Although expected standards have not yet been agreed, some form of testing will remain at the end of primary education (KS2) and secondary education (KS4) with the development of a 'scaled' score with the 'expected' standard being a scaled score of 100 (DfE 2014).

Interpretation of low achievement in France and identification of low achievers

There is no official definition of low-achievement in France and different forms of students' evaluation exist within the French School system.

Detecting low achievement in any subject includes using the results of the national tests in French and mathematics (primary years 2 and 5) and the portfolio designed for assessing the competences of the "Socle commun". Introduced by law in 2005 and implemented starting from 2010, the "Socle commun" is the body of knowledge, skills, values and attitudes that every student must acquire at the end of compulsory education. It is characterised by seven main competence areas, each subdivided in further domains. The third competence of the socle commun is the one related to Mathematics and Science: "Main elements of Mathematics and Scientific and Technological culture". The socle commun has been integrated within the new school programs and the evaluation of the core competencies is carried out by teachers during the ordinary lessons. Every student has a "Livret Personnel de Compétences" (LPC), where the teachers certify their mastery of the items connected to each competence (three levels of mastery are considered). Although all the competencies must be validated in order to prove the complete mastery of the socle commun, there is no requirement to validate these competences to pass the next grade. If the socle is not validated for a student, the teachers of the new school are asked to validate it, using the LPC as a reference to develop a personalised support for the student.

Two National assessment tests are proposed to students during the Elementary school, at the end of CE1 (cours élémentaire première année) and of CM2 (cours moyen deuxième année). They were introduced in 2008, in line with the implementation of the new curriculum for primary school, including the socle commun. They assess students' knowledge in French and in Mathematics, but they do not exactly evaluate the competencies of the socle commun, although its results can be used for validation of certain items. In tune with the use of the LPC, they also do not affect students' transition to the next grade.

The main objectives of these tests are:

- to provide the educational system with indicators on student achievement,
- to allow teachers to measure students' learning, detecting problems and identifying possible remedial strategies,
- to provide parents with an overview of students' achievement at two key levels for the socle commun,
- to show teachers what competencies students are expected to have developed at these levels.

The results of these tests are communicated to both students and their families. In case of remarkable difficulties highlighted through the tests, remedial paths are proposed to students.

Interpretation of low achievement in Germany and identification of low achievers

After the bad results of German students in international comparative studies like PISA, TIMSS or IGLU, there were a lot of changes in the German education system. From 2003 onwards the Standing Conference of the Ministers of Education and Cultural Affairs of the Länder in the Federal Republic of Germany (KMK, Ständige Konferenz der Kultusminister der Länder in der Bundesrepublik Deutschland, kurz: Kultusministerkonferenz, www.kmk.org) determined *national educational standards* to describe the aims of school education in the country. They define which acquaintances and abilities students should secure in a subject at a certain point of their school career. Therefore, they imply the change of the education system from input-oriented to a focus on the outcomes of educational processes. "At the primary level, the focus of these standards was on the core subjects of German and mathematics. At secondary level I, the focus was on German, mathematics, and the first

foreign language (English, French), with different standards for the lower secondary school-leaving certificate (HAS, Hauptschulabschluss), which is normally attained at the end of the ninth grade, and for the intermediate secondary school-leaving certificate (MSA, Mittlerer Schulabschluss), which is usually attained at the end of the tenth grade. For the science subjects biology, chemistry, and physics, educational standards were developed only for the intermediate secondary school-leaving certificate" (Pant et al., 2012, p.3). The standards are designed as normative standards and allow the identification of a student's level of competence and the comparison to other students (Klieme et al., 2007). These National Educational Standards are only recommendations as it is in the responsibility of every state to create their own curricula. Although all the ministers have pointed out that they rely on the national standards, the curricula differ a lot from state to state and within one state depending on the different types of school.

Since 2004 the Institute for Educational Quality Improvement (IQB, Institut zur Qualitätsentwicklung im Bildungswesen, https://www.iqb.hu-berlin.de) is leading the empirical review and advancement of the standards. A special focus lies on the development of proficiency level models (Kompetenzmodelle) as tools for interpreting test scores in national assessment studies. The models typically comprise five proficiency levels, with level II representing the minimal level (Mindeststandards), level III being the normative level (Regelstandards), and level V according to an optimal level (Optimalstandards). The minimum standards on proficiency level II determine which competencies are important in daily situations as well as a basic professional training. Hence, they define which competencies every student is expected to learn at least. Furthermore, these competencies characterize a risk group of students, who do not achieve the minimum standards and will consequently fail in basic mathematical or scientific situations in every day or their professional life (Vom Hofe & Hafner, 2009).

Although this view of low achievers as a risk group accords to the definition in the PISA study, the competencies which describe minimal standards are not completely developed yet, therefore it is still hard to precisely define low achievement in Germany.

German researchers have tried to give precise definitions of *underachievement*, which is the situation in which a student's achievement lies below the individual cognitive ability and the related expectations. To operationalise underachievement it is most common in educational psychology to compare the student's intelligence (measured in an IQ-test) with the results of school performance tests or the child's grades. Within this discrepancy model some authors define cut-off values to identify underachievers (e.g. student, who's IQ is above 120 and grades are below the median of the overall average grade distribution, is underachieving). More popular is a regression model, which predicts the student's accomplishment based on the measured intelligence. The idea is that the further the performance results are located from the regression line, the more contrary the student's achievement is (over- or underachievement). In order to define the allowed discrepancy, authors generally use the standard deviation of the dependent variable, the standard error of measurement or the standard error of estimate of the independent variable. However, the use of those methods to define underachievement is problematic in the German school system. In order to use the linear regression model, the variables have to be metrically scaled, which does not occur to the German scale of grades (1-6, with 1 being the best and 6 the worst grade to achieve). Furthermore, the different types of school lead to different standards in grading the students. The qualitative significance of grades thus depends on the type of school visited and cannot offer a common scale. Moreover, the term achievement includes two elements in our multi-branched educational system. Next to the student's performance, which can be reflected in the grade point average, it is above all the type of school and therefore the achievable graduation degree that determines professional possibilities in the future of a child. This is why Uhlig et al. (2009) found another possibility to define underachievement. First, they determine the average cognitive potential for learning (e.g. with an IQ-test) in a representative random sample of students visiting the three most common school types, namely Hauptschule (general school, offers Lower Secondary Education), Realschule (a type of Secondary

school ranked in between general school and gymnasium) and Gymnasium (providing advanced secondary education, comparable to "grammar school" in UK). Frequency scales of those potentials, in terms of opportunities to perform, can then be depicted differentiated after the type of school. Underachievement is afterwards defined by analysing the frequency scales in view of overlapping and includes two kinds of students. On the one hand Hauptschule students, whose cognitive potentials lie above the median of the Realschule pupils, on the other hand Realschule attendees, whose cognitive potentials are located above the median of the Gymnasium's frequency scale, are identified as underachievers. It is reasoned that these students have no opportunity to achieve a comparable graduation degree (Hauptschule compared to Realschule, Realschule compared to Gymnasium) even though their learning potential is as promising as of the better 50 % of students of the 'next better' type of school (Uhlig et al., 2009; Sparfeldt & Schilling, 2006).

Interpretation of low achievement in Ireland and identification of low achievers

In Ireland it is taken that 'low-attaining learners' are those who share the common feature of underachievement. Such groups typically include a disproportionate number of people from disadvantaged social and/or cultural groups, and in certain cases those without a good command of the English language.

Students are usually identified as having low achievement in Mathematics or Science based on their performance on tests (Baker, Gersten & Lee, 2002); these might be informal assessments designed by their teacher or they could be standardised tests, national examinations, or international surveys such as PISA or TIMSS.

There are many variables associated with low achievement: (1) at student level, home language, intention to leave school early, socioeconomic status, grade level, cultural capital, and books in the home are significantly associated with achievement in mathematics and science; (2) at school level, only school average socioeconomic status is statistically significant in the models (Gilleece, Cosgrove & Sofroniou, 2010).

The students are assessed separately at both primary and secondary level. At primary level students take part in standardised mathematics testing through the *Drumcondra Primary Mathematics Test-Revised* (DPMT-R). This is a group-administered, standardised test of achievement in mathematics, designed for pupils in Irish primary schools. The content of the DPMT-R is based on the 1999 Primary School Mathematics Curriculum. Student performance is rated by band ranging from 1-6. Students at band 1 are classified as having low-level achievement and are given additional resources to help them rise to a higher band. Students at primary level may also complete the SIGMA-T series of mathematics attainments tests that has been specifically developed and standardized for use in Irish primary schools. Results of standardised tests at primary level are generally given by STen (standard ten) scores, which range from 1-10. Students with a STen score below 4 may require additional help in mathematics.

Post-primary education consists of a three-year Junior Cycle (lower secondary; students usually begin this cycle at age 12), followed by a two or three year Senior Cycle (upper secondary), depending on whether the optional Transition Year (TY) is taken.

Students are assessed by sitting the Junior Certificate examination, taken after three years. The main objective of the Junior Cycle is for students to complete a broad and balanced curriculum, and to develop the knowledge and skills that will enable them to proceed to Senior Cycle education. A new *Framework for Junior Cycle* is going to make significant changes to the current Junior Cycle beginning in September 2014. This framework builds upon proposals developed by the National Council for Curriculum and Assessment (NCCA), adopting many of the curricular changes proposed by the NCCA, but it also contains more radical changes to how students' progress and learning are assessed at junior cycle. The terminal Junior Certificate Examinations will be replaced with a school-

based model of assessment where the emphasis will be on the quality of students' learning experiences. Under the new Framework, schools will be expected to deliver a programme that will enable students to develop a wide range of skills, including critical thinking skills and basic skills such as numeracy and literacy.

The assessment of Junior Certificate of the Science Syllabus involves a total mark allocation of 600 at both Higher Level and Ordinary Level, and consists of two practical coursework (Coursework A - 60 marks/10% and coursework B - 150 marks/25%) and a terminal written examination (390 marks / 65%).

Interpretation of low achievement in Italy and identification of low achievers

The Italian educational system is articulated in three main cycles: primary (from grade 1 to 5), lower secondary (from grade 6 to 8), and upper secondary (from grade 9 to 13). After lower secondary school, students can choose between three main kinds of upper secondary schools: lyceum, technical schools and vocational schools.

In Italy, the teachers have the responsibility of assessing students, documenting this assessment through periodical tests and choosing the appropriate assessment tools, consistent with the national curricula.

From 2004 the teachers also have the responsibility of certifying the competencies developed by students during kindergarten and the first cycle of instruction (primary school and lower secondary school), completing the Portfolio, a collection of all the most significant documents of the students' educational path (compulsory documents are the document of assessment, the certificate of admission, the vocational guidance, a document on pupil's progress, modalities of adherence / self-assessment of the pupil).

In order to foster an effective use of the Portfolio, the teachers are asked to: observe modalities and process of learning; select tests and adequate materials useful to describe personal competence; reflect upon elements and data inserted in Portfolio to improve teaching and learning strategies; stimulate pupils to self-assess their learning; co-operate with family in the development of educational processes; collaborate with a teacher when filling in the Portfolio; certificate the competences acquired by pupils; express indications in order to provide pupils with vocational guidance.

The identification of low-achievers and of the subsequent strategies to be implemented are therefore among the teachers' tasks. The teachers have to interpret the curricula, identifying what they think should be the minimum competencies to be developed by students in order to pass to the higher grade and selecting, on the basis of their achieved competencies, the students who need to attend to remedial courses.

In 2004 a research institute with the status of legal entity governed by public law was created to evaluate the effectiveness of the Italian Education System and its efficiency in the national context: the INValSI (National Institute for the Evaluation of Education and Training System).

The main aim of this institute is to identify proper policies and strategies to be adopted, verifying them, valuing their results and allocating resources. The evaluation process is carried out using annual National tests of learning aimed at pupils and students, compulsory for each school, and a questionnaire of System (aimed at analysing the social context). The tests, which involve only Mathematics and Italian, are self-administered by schools to students of grades 2, 5, 8 and 10. The main aim of the tests is to survey pupils' learning entering and exiting various education levels, in order to measure any value added by schools in terms of improvement of the pupils' learning levels. The tests for lower secondary schools' third year pupils are also part of the state examination, for certification purposes. The use of national testing results has not been defined yet by laws and regulations. At present, the Ministry of Education suggests that national test results could be used to

monitor learning level entering and exiting school, to evaluate school managers, and to evaluate teachers.

INValSI publishes an annual report on its activities. The 2014 report on the results of the national tests highlighted a profound gap between the Northern and the Southern Italian regions, with the Northern ones better performing. In particular this gap increases with the progress of students' school career.

Interpretation of low achievement in the Netherlands and identification of low achievers

Since 2008, in the Netherlands standard levels of achievement have been identified in order to standardize the intended achievement levels for language and mathematics. These so-called "reference levels" have been established by the Ministry of Education.

There are three main levels: one for the end of elementary school, one for lower secondary and one for higher secondary school (the latter two referring to levels of education in terms of difficulty, not age-groups). Each level is split into an S-level and an F-level. The S-levels describe the competencies that students should ideally attain; these are the ambition levels. The F-levels are the fundamental levels, i.e. the levels that students – also the students who have difficulties with mathematics – in any case should achieve.

The National Institute for Curriculum Development has provided documents describing operationalization of the reference levels. In particular elementary school teachers are provided with a checklist to decide whether a student needs a trajectory at the 1F level.

In the operationalization of reference levels, examples are given of what is expected within each domain of mathematics for both F-levels and S-levels. This ranges from basic number skills, such as verbalizing number words, to more advanced skills, such as using numerical information from tables and graphs to execute calculations. Problems on the 1S level are more difficult than on the 1F level. For example: problems on the 1F level regarding tables refer to specific rows of information, while problems on the 1S level require the child to select the appropriate row of information before proceeding with the calculation. A second example: problems on the 1F level require the child to make simple calculations with time (e.g., if you cycle 32km in 2 hours, how far will you cycle in 1 hour, and how far in 15 minutes), while problems on the 1S level require the child to make advanced calculations with time (e.g., compute the age of a person with a birth- and death-day).

The levels 2F and 2S build upon the knowledge gathered in the previous stage, and each consist of aims in all domains of mathematics. The knowledge required in 2S is more advanced than the knowledge required in 2F. An example: students are required to describe graphs in informal ways to achieve level 2F (rising, falling, staying the same, or repeating itself), while students are required to describe graphs in formal mathematical terms to achieve level 2S (growth, linear, exponential, periodical, constant).

If students do not match the level expected in 1F before the end of elementary school (at the age of 12), this is an indicator for remedial education being required.

However, also during elementary school teachers are stimulated to monitor the developments of their students carefully. For this they can use a so-called Student Monitoring System that gives scores and sub-scores to the students' performances and norm scores based on a national sample. The most often used Student Monitoring System is the one developed by Cito (Central Institute for Test Development).

Interpretation of low achievement in Norway and identification of low achievers

The Norwegian approach to student assessment is based on a mix of teacher-based classroom assessments and central examinations. Teachers hold the key responsibility for student assessment (both formative and summative) at all levels of the school system.

The Norwegian authorities have set up a national quality assessment system (NKVS) for the education sector in 2004. NKVS provides access to a range of data intended to help schools, school owners and education authorities evaluate their performance and inform strategies for improvement.

The first elements of NKVS were national tests at key stages of education. They are mandatory for Years 5, 8 and 9 and aimed at assessing students' basic skills in reading, mathematics and English. At the national level, results are used to inform education policy and allocation of resources towards municipalities with special challenges. At the local level, results inform school evaluation and improvement. So far, there are no national tests in science. Since 2012 there have been trials with "utvalgsprøver/karakterstøttende prøver" in science at year 10.

Other elements of the NKVS are a range of user surveys and a web-based School Portal. After a change of government, these elements were complemented by a number of tools to be used exclusively at the local and school level. The Mapping tests, in particular, are administered at school level for years 1, 2, 3 and Vg1 (upper secondary education, level 1). They are compulsory in year 2 and voluntary in years 1 and 3. These tests are not developed to diagnose specific difficulties. They are aimed at assessing how students use basic skills in reading and numeracy across the subjects and intended to uncover both individuals and groups within schools who have low skills and need extra help and adapted teaching. Samples of papers from mapping tests are collected to conduct some national analyses and to set the benchmark for the *lowest* 20%. Low achievers in Norway are therefore identified as the lowest 20% of performers.

Interpretation of low achievement in South Africa and identification of low achievers

South African students (called 'learners') enter formal education in the year they turn 6 at which stage they enter Grade R. This is followed by a further 9 years of compulsory formal education divided into three phases: Foundation Phase (Gr 1-3), Intermediate Phase (Gr 4-6) and Senior Phase (Gr 7-9). After Gr 9 learners can choose to complete the fourth and final phase of their basic education, the Further Education and Training Phase (Gr 10-12) at a high school or at a Further Education and Training (FET) college.

In South Africa, studying mathematics is compulsory until the end of the Senior Phase (i.e. Gr 9). Learners can then choose between Mathematics and Mathematical Literacy. Mathematics is required for entry into many university degrees but even so the majority of learners opt for Mathematical Literacy, often encouraged by their schools who want a good metric (Gr 12) pass rate as Mathematical literacy is generally seen as an easier option. The required time for mathematics is 180 hours per year of which 30 hours must be given to formal assessment.

The school year starts in January and has four terms. In the Senior and FET Phase, learners take examinations twice a year. Only the final school leaving examination is nationally set and marked but since 2010, the *Department of Basic Education* (DBE) has introduced Annual National Assessments (ANAs) as a strategy to measure progress in learner achievement annually, in an attempt to move towards the 2014 target of ensuring that at least 60% of learners achieve acceptable levels in Literacy and Numeracy. Although these tests are set on a national level, they are marked locally by each teacher and the marks then submitted to a central body. In 2010, only Gr 3 and 6 learners were assessed but by 2014 Gr 1-6 and Gr 9 learners were assessed and soon Grade 7 and 8 learners will also be assessed.

South Africa introduced a national curriculum in the years following the major political upheavals of 1994.

The current National Curriculum Statement comprises three documents:

- The Curriculum and Assessment Policy Statement (CAPS);
- the National policy pertaining to the programme and promotion requirements of the National Curriculum Statement; and
- the National Protocol for Assessment.

The CAPS document is much more frequently referred to by teachers than the other two, possibly because it specifies what needs to be taught each term in each grade for each subject. Teachers are also supplied with "pace setters" which specify which topics need to be taught on a week by week basis. It is normal in government schools for all lessons for all grades to be suspended during two examination periods in the year and children may not attend school unless they are writing an examination. There is often little or no feedback to learners on these examinations.

Two major challenges faced by South African teachers are large classes and the language of instruction. In terms of class size, it is common to find over 50 learners in one class, with one teacher, and in a space that is too small to allow teachers to move around the classroom.

There are 11 South African languages and up to Grade 3 it is usual for all lessons to be in the home-language of the learners. From Grade 4, the language of instruction, also known as the language of learning and teaching (LOLT), is English or Afrikaans. In many rural schools it is often the case that nobody speaks English outside the school classroom. A concern raised by teachers is that learners seem to understand the mathematics during the lesson but then do badly in written tests. One possible reason for this is that teachers often interpret questions in class to learners using code switching because the learners struggle with the LOLT. This means that learners rarely have to read the question in the LOLT by themselves except in formal written tests.

For mathematics education in South Africa, however, possibly the greatest challenge is the teachers' lack of subject knowledge in mathematics. For example, according to the 2005 Southern and Eastern Africa Consortium for Monitoring Educational Quality report(SACMEQ) only 32% of Grade 6 maths teachers in South Africa had desirable subject knowledge. It seems that, possibly because of lack of subject knowledge, many teachers do not cover specific areas of the curriculum, which is seen as a major problem in the country.

Learner achievement on the Annual National Assessment, in Grades 1-6 and 9, is graded on a seven point scale. So, in all grades, at least 50% is required in order to be deemed to be performing at the "adequate achievement" level (DBE website).

RATING CODE	DESCRIPTION OF COMPETENCE	PERCENTAGE
7	Outstanding achievement	80 – 100
6	Meritorious achievement	70 – 79
5	Substantial achievement	60 – 69
4	Adequate achievement	50 – 59
3	Moderate achievement	40 – 49
2	Elementary achievement	30 – 39
1	Not achieved	0 - 29

In terms of the different levels of performance for Numeracy/Mathematics in 2013, quoted in the speech of the minister of basic education (DBE website):

In Grade 1, 71% of learners achieved above 50%, compared to 77% in 2012.

In Grade 2, 70% of learners achieved above 50%, compared to 68% in 2012.

In Grade 3, 59% of learners achieved above 50%, compared to 36% in 2012.

In Grade 4, 27% of learners achieved above 50%, compared to 26% in 2012.

In Grade 5, 21% of learners achieved above 50%, compared to 16% in 2012.

In Grade 6, 27% of learners achieved above 50%, compared to 11% in 2012.

In Grade 9, 3% of learners achieved above 50%, compared to 2% in 2012.

The majority of learners in South Africa, especially in Grade 9, are therefore considered low achievers.

Another indication of the overall level of achievement of South African learners is the number of learners who have to repeat a school year. In 2011, 1.2 million (11.1 %) of the 11 062 399 learners in the South African school system 2011 had to repeat their school year (Van Wyk, 2012).

Comparative analysis of the ways of identifying low achievers in the FaSMEd countries

The analysis of the different ways in which low achievers are identified in the participating countries enabled to identify different perspectives according to which the comparison between the different school systems could be developed:

1) Range of diagnostic tools to identify low achievers
2) Role of the National standards in the identification of low achievers
3) Role of National tests as diagnostic tools
4) Role of the teachers in the assessment processes
5) Institutional indications to carry out students' assessment

The results of this comparative analysis are summarised in Table 1 (reported in Appendix).

D2.1.2 Typical trajectories for low-achievers in the FaSMEd countries

Introduction to this theme

The "Strategic framework for European cooperation in education and training" (ET 2020) sets a series of reference levels of European average performance ('European benchmarks') to support the strategic common objectives to be addressed in the period 2010-2020. One of the five benchmarks refers to "low achievers in basic skills": "…*ensuring that all learners attain an adequate level of basic skills, especially in reading, mathematics and science - By 2020, the share of low-achieving 15-years olds in reading, mathematics and science should be less than 15 %*". In the document it is stated that the Member States are invited to consider how and to what extent they can contribute to the collective achievement of the European benchmarks through national actions.

In the report "Developing Key Competences at School in Europe: Challenges and Opportunities for Policy", it is suggested that the problem of low achievement is an issue associated not only with the effectiveness of teaching and learning, but also with providing an equitable system of education.

The report identifies specific factors that can be directly influenced by education policies with the aim of fostering the development of equitable systems of education:

(a) developing approaches that comprise measures that are suitable for all students, but benefit underperforming students in particular;

(b) providing targeted support for students with individual needs both inside and outside the normal classroom;

(c) enabling the availability of qualified primary teachers who have solid foundations in teaching reading and mathematics-related knowledge and skills for teaching;

(d) taking motivational factors into account;

(e) increasing parental involvement in the learning process.

It is also observed that, in the majority of European countries, central education authorities provide guidance and support to teachers and schools to address low achievement, but it is usually up to the individual classroom teacher to decide whether and what type of support should be given. Usually no distinction is made between subjects: specific policies seem to exist only for literacy and numeracy at central level, while for other curriculum areas such as science or foreign languages, only small scale projects are documented.

The analysis of the typical pathways for low-achievers through the FaSMEd countries' school systems confirmed these results. In the following paragraphs these pathways are examined, through the analysis of the different remedial interventions that are conceived and implemented by governmental agencies.

Pathways for low achievers in England

In mathematics the most recent government report comes from the Office for Standards in Education, Children's Services and Skills: "Mathematics: made to measure" (Ofsted, 2012). A key message of this report is that pupils of different ages, needs and abilities receive significantly unequal curricular opportunities, as well as teaching of widely varying quality, even within the same year group and school. Moreover: "differences and inequalities extend beyond the teaching: they are rooted in the curriculum and the ways in which schools promote or hamper progression in the learning of mathematics" (Ofsted, 2012, p. 4). Marks (2014) refers to this process as 'educational triage' which she defines as: "a process of goods distribution whereby a number of linked practices are enacted to achieve a specified aim, usually related to maximising attainment outcomes" (Marks, 2014, p. 38) However, as Marks notes: "practices associated with triage achieve the aim of increasing the number of pupils meeting Government targets, yet leave some – the lowest attaining pupils – with reduced mathematical learning experiences" (*op cit.* p38).

In the "Mathematics: made to measure" report it is stated that the challenge for school is to raise the achievement of the lower and middle attainers without suppressing that of the most able, too many of whom are also underachieving. The aim is to improve progression for all pupils, so that all are mathematically equipped for their futures.

Figures for 2011 show that 80% of children reached the expected level at the end of primary schooling (age 11) and 64% achieved the expected level at age 16 with very wide levels of attainment at age 16.

Data show that progression rates vary widely, with higher-attaining much more likely to make the expected progress than average or lower-attaining ones. In fact, the minority of pupils who do not meet the expected standard grows by key stage: in 2011, 10% of seven-year-olds did not reach Level 2, 20% of 11-year-olds did not reach Level 4, and 36% of 16-year-olds did not gain at least grade C at GCSE, although only 5% of the whole cohort did not gain a GCSE qualification at grade G or better.

Moreover, independent research appears to show that there has been little change in the level of children's understanding of mathematical concepts over the past 30 years with a plateau effect after the age of 11. Moreover, the achievement of the expected level at age 16 appears not to be sustained into adult life with an estimated 78% of adults in the UK whose understanding of 'numeracy' is below level 2 (the expected grade at age 16).

The PISA (2009) and TIMSS (2007) surveys show that in the UK pupils are achieving amongst the highest scores for science in the EU, although still substantially less than the highest achieving countries (Eurydice report on science in Europe, 2011). The Figures for 2012 show that 86% of children achieved the expected level at the end of primary schooling. The variety of awards at age 16 make a direct figure difficult to achieve, but in 2012 77% achieved the expected grade across all science awards at age 16. The Ofsted reports in 2011 and in 2013 highlight good or outstanding progress of students in science.

As in the case of mathematics, independent research problematizes these figures and actually shows a decline in the level of understanding at age 11 for some concepts (Shayer & Ginsberg, 2009).

In both mathematics and science the most common strategies to raise attainment focus on the use of assessment data to track pupils' progress in order to intervene to support pupils at risk of underachievement. Both primary and secondary schools operate a system of 'educational triage', which achieve the aim of increasing the number of pupils meeting Government targets.

Another approach is students' subdivision in different sets, according to their attainment. The Ofsted report highlights that almost all the secondary schools visited placed pupils in sets for both mathematics (in Years 8 to 11) and science (after year 14). A few had mixed-ability classes in Year

7 for mathematics, but the majority set early in Year 7, sometimes after testing all the pupils as well as, or instead of, using information from primary schools coupled with national test and teacher assessment data. Post 14 schools are increasingly offering awards in separate sciences for the higher attaining pupils with the lower 'sets' studying generic science.

Pathways for low achievers in France

As observed before, in France the procedures to detect learning difficulties in any subject include using the results of the national examinations in French and mathematics and the portfolio designed for assessing the competences of the Socle commun, as well as using assessment materials developed by teachers.

As regards the possible remedial paths proposed to students, at primary level the Ministry has prescribed two hours of personalised work per week, which can be used for remedial work with the students identified through the two National assessment tests in classes CE1 and CM2. Support usually lasts a few weeks but varies according to the pupil's difficulties and progress made. At the end of the programme, a project-based assessment allows a decision to be taken on the need for any additional support.

Moreover, each school develops a specific program for low achievers: "Programme personnalisé de réusite educative" (PPRE, in English "personalized program of educational success"), which is offered to all students who risk to not achieving the objectives of the Socle Commun.

PPRE can occur at any time of compulsory education according to the needs of each student. It is a contract between families and the school, which aims to ensure consistency of the given aids. It is systematically offered to students and families in case of year repeating and to all the students who are struggling but do not have specific learning disabilities. The identification of these students is the responsibility of teachers, who regularly assess student achievement.

Through a PPRE, the head teacher and the headmaster in secondary school, or the teacher and director of the school, offer the student and his family an assistance plan targeting knowledge and specific skills. Also other professionals of education (psychologists, specialized teachers, school doctor...) could be involved.

The PPRE focuses primarily on French and mathematics and, in lower secondary school, on the first foreign language. Only in rare cases does it focus also on science subjects. Organized under the responsibility of the teaching staff, it usually comprises support measures such as differentiated learning, small group instruction and sometimes ability grouping.

Support usually lasts a few weeks but varies according to the pupil's difficulties and progress made. The PPRE also provides the procedures for evaluating student progress.

At the end of the programme, a project-based assessment allows a decision to be taken on the need for any additional support.

Since the class teacher is asked to provide the necessary support to these students, in 2009/10, a specific in-service training course was organised for primary teachers.

In primary schools, some teachers and psychologists are organised in specialized networks to assist pupils (réseaux d'aides spécialisées aux élèves en difficulté, RASED) to provide specialized assistance to elementary schools where students demonstrate local or permanent learning difficulties, behavioural problems or are lacking motivation.

The students involved in these specific paths are defined as those who, during the kindergarten, "draw the attention of teachers as their attitudes, responses to instructions and their adaptation to community life reveal difficulties that may interfere with their academic future", or, during the elementary school years, "are well below the requirements of the programs" (education.gouv.fr).

This assistance is furnished in or outside classroom context and discussed within these networks, including the student's teacher.

The first year of lower secondary school as well as in high school, special courses (accompagnement personnalisé) can be organised for low attainers, who still have to be identified by teachers.

Pathways for low achievers in Germany

All students in Germany visit primary school for at least four years from age 5, 6 or 7 till they are 9, 10 or 11 years old (in Berlin and Brandenburg primary school is attended for six years). After those years students move on to different types of secondary schools based on their level of competence. The most common types of schools are Hauptschule (general school), Realschule, Gymnasium (increasing in the achievable graduation degree), and Gesamtschule (comprehensive school). The decision about which school a child attends is made differently in each state (Länder). Usually the primary school gives the student a recommendation based on the achieved grades, the child's learning strategies and behaviour. The parents might then decide on a secondary school or if they want their child to do a qualification examination. Sometimes (e.g. in Bavaria) the grades determine a child's secondary school type. Nevertheless, it is highly influenced by the primary school recommendation in every state. Therefore, a student's achievement in primary school will most likely determine his or her future education. Besides the differentiation of students after primary school, there are binding state assessments that each student has to attend. In Northrhine-Westfalia these are held in grades 8 and 10 in the subjects mathematics, German and either English or French (first foreign language) in the form of a pencil and paper test. The aim is to evaluate the level of competence each student has reached as well as to collect data for educational evaluation and administrational purposes. Furthermore, low achieving students are constantly identified through amongst others grading, examinations, performance tests (summative assessment).

In 2010, the *Resolution of the Standing Conference of the Ministers of Education and Cultural Affairs of the Länder* called for action to reinforce individual support through diagnostic procedures as a basis for assistance and differentiated support beyond normal lessons. It also proposes the development of new forms of learning through the use of new teaching materials, teaching small groups of pupils with similar achievement levels and alternative forms of learning that strengthen the links with the world of work.

Pathways for low achievers in Ireland

After the 2009 PISA report, a major emphasis was put on improving students' literacy and numeracy skills in Ireland. "*Literacy and Numeracy for Learning and Life: The National Strategy to Improve Literacy and Numeracy among Children and Young People 2011-2020"* is the Irish national strategy to improve literacy and numeracy standards among children and young people in the education system. This strategy seeks to address significant concerns about how well young people are developing the literacy and numeracy skills that they will need to participate fully in the education system, to live satisfying and rewarding lives, and to participate as active and informed citizens in our society. In 2011 arrangements in relation to assessment were set out under this program.

At primary level low attaining students are identified in two ways: through teacher designed class tests that assess them on various parts of the curriculum and through standardised tests.

A document, "*Assessment in the Primary School Curriculum: Guidelines for Schools*", has been developed to support teachers' knowledge and understanding of assessment, and to assist schools in developing and implementing an assessment policy. The guidelines provide examples of how teachers gather information about children's progress and achievement and use this information to enrich teaching and learning.

Standardised tests, in particular, are used to measure reading and mathematical achievement and to determine their progress in those areas. All primary schools are required by the Department of Education and Skills to administer standardised tests: medium schools are required to administer standardised tests in reading and mathematics for all students in 2nd, 4th and 6th classes on an annual basis.

The National Council for curriculum and assessment states that "standardised tests are used to identify pupils with learning difficulties at the earliest possible stage so that appropriate support and intervention can be put in place. While standardised tests do not indicate the nature of a learning difficulty, they are used to flag potential difficulties and prompt further assessment." (NCCA, 2005)

Where there is concern arising from these standardised procedures, that pupils may be underachieving in certain areas of academic attainment (namely key areas of literacy and numeracy), then the class teacher/principal refers child to Learning Support Team in the school. The team then takes a staged approach to supporting the pupil or a small group of pupils as outlined by the National Educational Psychological Services (NEPS) model under the remit of the Department of Education and Skills.

NEPS endorse and promote a staged-approach to assessment and intervention in line with a Response to Intervention (RTI) approach to assessment and intervention. This process involves 3 stages.

The first stage is *the classroom stage* (involving liaising between parents, teacher(s), child over concerns and provision of within-classroom support through team- teaching initiatives) is characterized by the following steps: (a) concern expressed by parents and/or teachers on learning or behaviour, (b) learning plan drawn up and implemented for at least one term, (c) review and either the child finishes and returns to normal programme, continues plan for a further period of time or moves to Stage 2.

The second stage is the *school support stage* (may provide extra literacy/numeracy support in form of small-group setting or individual-level tutoring in addition to further in-class support through team-teaching initiatives), involving these steps: (a) class teacher informs parents, principals and school care team of continuing concerns, (b) revised learning plan drawn up by appropriate teachers and parents and implemented for at least one term, (c) review and consultation and either the child finishes plan and returns to normal programme, returns to Stage 1, continues with plan for further period of time or moves to Stage 3.

The third stage is *the school support plus stage*. It involves: (a) formal request for NEPS involvement through provision of full individual psycho-educational assessment, (b) plan for intervention collaboratively drawn up with formal Individual Education Plan implemented for at least one term, (c) monitored closely for Response to Intervention.

Students are usually withdrawn from their normal classes and taught within small groups, but, as it is observed in the Eurydice report "*Developing key-competences at school in Europe*" (2012), currently other strategies complement the learning support provision, such as in-class cooperative support, one-to-one withdrawal and team teaching also feature, because of a growing emphasis on the provision of support to individual students within the classroom.

The provision of resource hours follows a general allocation model that enables schools to:

- Ensure that additional teaching support is provided in a timely manner;
- Deploy additional teaching resources in a flexible manner, leading to more effective and efficient delivery of services;
- Ensure that permanent access to additional teaching support is available in schools for pupils with special educational needs arising from high incidence disabilities;
- Put in place transparent and equitable whole-school plans and procedures for the selection of pupils for additional teaching support;

- Ensure that additional teaching resources are allocated differentially to pupils in accordance with their levels of learning need;
- Allow for the grouping for additional support of pupils with similar needs as appropriate; and
- Allow for in-class as well as out-of-class teaching support by the learning-support/resource teacher.

Pathways for low achievers in Italy

As stated before, in Italy the assessment and the consequent identification of low achievers is the responsibility of teachers. The identification of proper trajectories for these students has been the focus of specific laws and decrees in the last 15 years.

The legislative decree n.59 (2004), which ratifies general norms for the first cycle of instruction (primary school and lower secondary school), states that school institutions should aim at realising the personalisation of students' plans of study, organizing optional and free extra educative and didactical activities. These extra activities are part of the so-called "Piano dell'offerta formativa" (POF, in English "Plan of formative offer"), which every school has to plan at the beginning of the school year. The POF provides activities aimed to fully guarantee the right to inclusion, education, training and achievement, on the basis of emerging local needs. These activities are autonomously organised by the different schools, in tune with the idea of didactical and organisational flexibility that characterises Italian school autonomy (law n.59, 1999). In the National Report on the development of education and training (2004-2008) it is specified that each school has, in fact, the opportunity to devote up to 20% of curriculum time to specific projects. Among them, the report indicates "increasing tuition time in specific knowledge domains in favour of underachievers" and "designing remedial courses". The remedial courses are therefore part of these activities and must be planned according to the results of the periodical students' assessment.

In 2007, after the negative results of Italian students in the PISA tests, the ministerial directive n.113 promoted specific recovery interventions, in Italian and in mathematics, starting from the first year of lower secondary school. The directive established the use of specific financial resources to enable the schools to organise gradual plans to support students' learning and fill the gaps in their preparation, with the aim of preventing school dropout and contrasting students' failure. The directive suggests that schools should plan diversified models of intervention, according to students' specific formative needs, privileging the organisation of group activities for the students, subdivided according to their level.

In 2007, the Ministerial Ordinance n.92 was designed to help upper secondary school underachievers reach the standards and to support students with weaknesses in several knowledge domains. In the Ordinance it is written that "remedial activities are permanently part of the POF that each school institution annually plans". They have to be planned and realised by each class council (that is by the group of teachers who teach in the same class). The didactical-methodological criteria for this planning are stated by the school council (constituted by all the teachers who work in the same school). Remedial courses must be carried out: (1) during the school year (approximately in February and March), for those students who receive unsatisfactory marks in the first term evaluation; (2) in the summer, for those students who still receive unsatisfactory marks in the end of the school year (these students are not temporarily not admitted to the following grade and have to be evaluated in September, before the beginning of the following school year).

Schools are required to identify those subjects or disciplinary areas for which remedial interventions are needed. According to the received financial support, schools have to autonomously choose: (a) how these interventions must be organised and realised; (b) the duration of the interventions (at least 15 hours during the whole school year); (c) the didactical-methodological models to be referred to;

(d) how to verify students' results at the end of the interventions; (e) the evaluations criteria; (f) how to communicate with students' families.

Other forms of interventions to support students with the aim of preventing school failure (such as remedial activities to be developed during the ordinary lessons or afternoon assistance to students who need aid) could be planned starting from the beginning of the school year and are considered part of the remedial activities.

The class council are responsible for the identification of the subjects that should be object of remedial courses, for the indication of the objectives of remedial interventions and for the certification of students' final outcomes.

Pathways for low achievers in the Netherlands

In elementary education, pupils are tested regularly using two distinct approaches: approximately eight times a year, they are assessed on the specific skills and knowledge taught during mathematics lessons using textbook-based tests. In addition, most schools apply standardized testing in which scores are based on national norms. This is not mandatory, but highly customary. The most common tool for this is the Student Monitoring System developed by Cito. This tool can be used to monitor individual and class development of students using a broad battery of tests conducted twice per academic year. These textbook-based tests and standardized tests are used for preliminary identification by the teacher of students with low achievement. In addition, CITO provides a general test of scholastic attainment to be administered in the final year of elementary school (group 8; 11 to 12 years-olds). This test (or a similar test) is compulsory and is used to allocate a student to a particular level of secondary school: vmbo, havo, or vwo (in which vmbo belongs to the vocational track, havo prepares students for a higher vocational study and vwo is the pre-university track). For the first three years of secondary education, for mathematics a similar monitoring system is available as in elementary school, but this system is split out into the various educational levels. These tests are administered twice during the first year of secondary school, and once during the second and third year of secondary school. Use of the test is less common than in elementary education.

If a teacher registers a delay in mathematics in elementary school, a first step is taken by providing additional instruction to the student, in groups or individually. Mostly, concrete materials are used to demonstrate abstract concepts, and often the students are trained to use for every operation just one strategy. However, there is some debate about this rigid approach. Many schools have remedial teachers to assist in extended instruction, or internal counsellors to assist the teacher in decision-making about how to give support to their low attainers.

In the case of severe problems with mathematics, specific protocols have been developed for the use in educational practice. Since 2008, the Netherlands has been moving towards the implementation of a new policy called 'appropriate education'. Compulsory schools in the Netherlands are faced with challenges in trying to include children with special needs in mainstream schools. One of those challenges is that teachers have to cope with a larger group of children with different needs. Several measures and ICT programs have already been set up in order to support these teachers by providing them with tools for designing appropriate education.

One of these programs is STAP (*SLO Tool to Arrange Educational Plans*). The SLO is the national institute for curriculum development in the Netherlands. This is an ICT tool for mathematics that can be used to design and develop a personalised educational arrangement for children with special needs. This tool consists of three steps. The first step helps a teacher formulate individual needs of students by providing a framework for listing and analysing individual students' achievement and profile. The second step is designed to formulate individual goals for students and drawing up a plan to assist each

student in achieving these goals. This can go from unguided in-class assignments to extensive remedial teaching outside the classroom. A third step consists of evaluation of previous goals and reformulation of consecutive goals.

Other protocols were developed for students with specific learning disorders.

The "Protocol for students with dyscalculia" uses criteria of severity, delay, and learnability, the diagnostic process is set out for behavioural experts in order to accurately diagnose students with mathematics learning disorder. Another protocol is "The severe mathematics difficulties and dyscalculia" (ERWD), which is available to all schools, and is not only meant for diagnostic purposes, but provides guidelines for remediation, procedures, materials to offer to students with dyscalculia, and evaluation of remedial education using principles of evidence based practice. If students do not perform up to the expected levels with these guidelines, they often receive separate instruction and aims from group 6 on (9-10 years). These students are often directed towards practical education by the end of elementary school.

Both of these protocols are aimed towards specialists in remedial education. Diagnosis and intervention in the case of dyscalculia or severe mathematical delays is no longer the responsibility of the class teacher. When problems are so severe that a student is redirected towards special education, indication must be requested at the Permanent Commission Pupil Care (PCL, for elementary special education) or the Commission for Assessment (CVI, for secondary special education).

Assistance with the design of this remedial education is provided in a national project called "*Passende Perspectieven*" (Fitting Perspectives). On their websites, aims of mathematics education are listed, along with elaborate descriptions of the way this achievement can be mapped, which problems can occur and how to respond to problems in one or more domains. More tangible guidelines, such as guidelines for remedial education, are still under development. Products developed in this project are now primarily used in schools for special education, but as of August 2014, also regular schools will be required by law to offer internally remedial care for students instead of referring their low-achieving students to special education.

The initiative Masterplan Dyscalculia has the same aims, using the ERWD protocols. It supports schools in the implementation of remedial education for children with severe problems in mathematics. It is active in elementary school, secondary school, vocational education, and special education, and tasks of the Masterplan Dyscalculia include informing schools and teachers of the protocols and available remedial tools through conferences and a website, answering questions about mathematics difficulties and dyscalculia, and supporting the use of the ERWD protocols.

The initiatives listed above are aimed towards elementary school. Although there is special secondary education, and the ERWD protocol covers students into the first two years of secondary education, most of the initiatives to remediate delays in mathematics during secondary education are scattered, and students have to rely mostly on private tutors. Specific paths of remedial education are only funded for students diagnosed with a specific learning disorder or those already referred to special secondary education.

Pathways for low achievers in Norway

The Norwegian Educational Act states that education shall be adapted to the abilities and aptitudes of individual pupils: all students have the right to "*tilpasset opplæring*" (differentiated learning, education adapted to their abilities and needs). For this reason, the students in the group of the lowest 20% performers in the mapping tests are provided with extra follow-up and adapted teaching.

The report "Developing key competences at school in Europe" indicate Norway among those countries where central authorities issue relatively general recommendations that leave the choice of

practical measures entirely to the discretion of teachers: school providers are responsible for providing all the tools and support mechanisms necessary for the completion of the achievement goals that have been set for each education level.

Differentiated learning includes also special education. Teachers or parents can ask for an assessment to see if the pupil would have the right to this form of education. Before a decision concerning special educational assistance is made, an expert assessment has to be made of the pupil's specific needs. This assessment shall determine whether the pupil needs special education, and what kind of instruction should be provided.

The expert assessment shall consider and determine the following:

– the pupil's learning outcome from the ordinary educational provisions;

– learning difficulties the pupil has and other special conditions of importance to education;

– realistic educational objectives for the pupil;

– whether it is possible to provide help for the pupil's difficulties within the ordinary educational provisions

– what kind of instruction it is appropriate to provide.

The percentage of students receiving this kind of support was more than 8% in 2009 and 8.41% in 2011 and it seems to be growing (NOU 2009: 18 Rett til læring).

Pathways for low achievers in South Africa

The identification of low-achievement in South African schools focuses more on whole school achievement.

The Annual National Assessments (ANAs) are, among other things, used to identify low achievers. They are administered in Gr 1- 6 and Gr 9, with plans to roll out testing for Gr 7 and 8 learners.

The ANAs are intended to be used on two levels – to identify low achieving learners and low achieving schools – although in most cases they are used to identify low achieving schools. Even though reporting on items of weakness is required by some provincial departments of education, the normal interpretation of results is on what the individual learner attained (and no consideration for what a particular item reveals about areas of weakness). This means that many teachers are not able to use the ANAs to plan interventions or adjust their teaching strategies.

On the other hand, good teachers can usually identify the 'at risk' learners even without the help of the ANAs. Anecdotal evidence suggests that even when these at risk learners are identified, however, they are often promoted to the next grade. This seems to happen for a number of practical reasons and it appears that policy or published guidance for teachers does not provide advice related to specific interventions consequent to their identification.

Once low performing schools have been identified, they are targeted for focussed interventions to improve results. These interventions are normally training sessions for teachers in the content that seems problematic in their diagnostic report and extra tuition for learners in the form of after school or Saturday tutorial sessions and holiday classes.

Comparative analysis of the of the possible pathways for low achievers in the FaSMEd countries

The comparative analysis of the pathways available for low-achievers within the FaSMEd countries' school systems enabled to identify specific categories corresponding to the different possible strategies adopted to enables students to raise their achievement:

a) Differentiated teaching
b) Follow-up teaching
c) Setting
d) Small-groups tuition outside the classroom
e) Individual tuition
f) Support given to the teachers by the schools: networks of teachers and psychologists, remedial teachers,

The results of this analysis are summarised in Table 2 (reported in Appendix).

D2.1.3 National or regional studies/initiatives concerning low achievement in Mathematics and Science in the FaSMEd countries

In order to highlight all the educational opportunities that are open to low achievers in the participating countries, different projects, studies and other initiatives developed in the participating countries are examined in the following paragraphs.

Projects concerning low achievement in England

There have been a wide range of initiatives in both mathematics and science education in England prompted both by educational and economic concern about attainment and the numbers of science, technology and mathematics graduates and about the low levels of numeracy in the adult population. Government funding for both science and mathematics initiatives has been relatively generous and independent and not-for-profit or charitable institutions have also been involved across all phases of education.

At a national level in England, concern about children's attainment in mathematics and literacy levels caused the government in 1997 to fund an initiative called the '*Numeracy and Literacy Strategy'* in primary schools – the focus of this initiative gradually expanded to become the 'Primary Strategy' covering a wide range of subjects and topics and expanded to secondary schools as the 'Secondary Strategy'.

The strategies gave advice and guidance on how the subjects should be taught and the amount of time that should be allocated (for example, recommending an hour each day on 'numeracy' and 'literacy' in primary schools and in secondary schools developing schemes of work which mapped out the whole curriculum to 16 in mathematics, English and science).

Extensive sets of resources and professional development training were developed with large numbers of 'consultants' appointed to deliver this training to schools.

The strategies continued to expand and develop their scope (for example £150 million was allocated in 2008 for 'Assessment for Learning' to apply the ideas of the Assessment Reform Group – focused on formative assessment). However, the election of the coalition government caused a change in policy which halted and disbanded the strategies. Materials produced have been archived online and continue to be available for teachers and advisors.

In March 2001, Sir Gareth Roberts was asked by the Chancellor of the Exchequer and the Secretaries of State at the Department of Trade and Industry and at the Department for Education and Skills to undertake a review into the supply of science and engineering skills in the UK. The review was commissioned as part of the Government's productivity and innovation strategy. The Roberts' Report "*Set for Success*" sets out a series of recommendations to the Government, employers and others with an interest in fostering science, engineering and innovation in the UK.

The Review made a number of recommendations, across the spectrum of academic and vocational courses, aimed at: Improving the relevance of the science curriculum to pupils in order to capture the interest of pupils (especially girls) and to better enthuse and equip them to study science (particularly the physical sciences) at higher levels; ensuring that pupils stand a broadly equal chance of achieving high grades in all subjects (in particular, ensuring that it is not more difficult to achieve high marks in science and mathematics, as currently appeared to be the case); ensuring that pupils are able to make the transition smoothly from GCSE to AS- and A-level and in turn to further and higher education in science and mathematics; and providing easier access for teachers, schools and colleges to the many independently organised initiatives (for example, the Crest Awards and the Industrial Trust) to enhance the science, D&T, mathematics and ICT curricula.

Different initiatives were developed as a consequence of this influential document.

In response to a recommendation in SET for Success, in 2002 the Government announced that there would be an Inquiry into post-14 mathematics education. Principal of Queen Mary, University of London, Professor Adrian Smith FRS was appointed chair of the Inquiry.

The inquiry, reported in 2004 in the "*Making Mathematics Count*" report, identified three key issues of major concern and made recommendations to address them: the shortage of specialist mathematics teachers, particularly in England and Wales; the failure of the current curriculum, assessment and qualifications framework in England, Wales and Northern Ireland to meet the needs of many learners and to satisfy the requirements and expectations of employers and higher education institutions; the lack of resources, infrastructure and a sustained continuing professional development culture to support and nurture all teachers of mathematics.

In 2004 the government also funded '*science centres*' across England in order to provide training and a National Centre for Excellence in Teaching Mathematics (NCETM) which is an online source of guidance and resources, as well as a network of consultants to provide training and advice in the regions (https://www.ncetm.org.uk/). The current government continues to support these initiatives, albeit on a reduced budget and scope.

In England, the *Science, Technology, Engineering and Mathematics (STEM) programme* – which began in 2004 and was scheduled to run for 10 years – was implemented to increase students' STEM skills in order to: provide employers with the skills they need in their workforce; help to maintain the UK's global competitiveness; and make the UK a world-leader in science-based research and development.

The STEM Programme has eleven areas of work (known as action programmes) focusing on teacher recruitment, continuing professional development, enhancement and enrichment activity, curriculum development, and infrastructure. Each area of work is driven forward by a specialist lead organisation, working collaboratively with the National STEM Centre. This centre was opened in 2009. Its key objectives are to house the UK's largest collection of STEM teaching and learning resources, which will provide teachers of STEM subjects with access to a wide range of support materials; and to bring together STEM partners with a shared mission to support STEM education, thus supporting the STEM Programme.

In England, *STEMNET, the science, technology, engineering and mathematics network* creates opportunities to inspire young people in science, technology, engineering and mathematics (STEM) which, in turn, enables them to develop their creativity, problem-solving and employability skills, widen their choices and support the UK's future competitiveness. STEMNET helps encourage young people to be well informed about STEM, able to engage fully in debate, and make decisions about STEM-related issues. It is funded by the Department for Business, Innovation and Skills (BIS) and Department for Education (DFE) and runs three programmes to help realise its vision: STEM Ambassadors where people from STEM backgrounds volunteer as inspiring role models for young people; Brokerage of STEM Enhancement and Enrichment on which STEMNET co-ordinates 52 organisations to fulfil a brokerage role to schools. Through strong links with business organisations the brokerage service aims to ensure that all schools and colleges can offer their students programmes which support the curriculum and increase the quality and quantity of students moving into further STEM education, training and development. STEMNET also oversees the coordination of the network of After School Science and Engineering Clubs (ASSECs).

In mathematics, there have been a series of funded projects focused on raising attainment starting in the 1980's, usually managed by a higher education establishment. The first was LAMP (*Low attainers in mathematics project* 1983-1986) (Ahmed 1987) then RAMP (*Raising attainment in mathematics project*) (Ahmed and Williams 1991). This project followed on from LAMP and was effectively a much larger roll out of the earlier program. It involved 34 local authorities organized into five regions; each region had a co-ordinator and typically two teacher-researchers released from each local authority for one day per week.

IAMP (*Improving attainment in mathematics project*) (Watson, De Geest et al. 2003) was also focused on low attaining students. The purpose of the project was to introduce innovations in practice through action research with 10 teachers over 2 years, and evaluate the effect on students' learning using national test scores, teachers' reports, non-routine tasks and other performance indicators. However: "While it was found that learning improved, the methods and strategies the teachers used were not always generalisable across the project, indeed some were contradictory… Overt methods were less important than the collection of beliefs and commitments which underpinned teachers' choices. There was, however, a convergence of practice around a focus on long-term development, the process of becoming a learner of mathematics, rather than short-term gains." (Watson and De Geest, 2005 p. 209) All these projects were clearly focused on 11-16 secondary education.

A later influential project, *Improving Learning in Mathematics* (ILM), was focused on post 16 learners, however, this was so successful that many secondary mathematics departments adopted its approach for the 11- 16 phase. The "Standards Unit: Improving Learning in Mathematics" resources were produced as a response to the Smith report. The materials use active learning approaches originally designed for post-16 mathematics but for use across the secondary phase. The resources, and the work of the Standards Unit with leading maths experts in the country, were part of the Department for Education and Skills' response to the Smith Report and offer practical and effective ways to improve learning in mathematics.

The resources were developed from the work of Susan Wall, a Gatsby fellow working at Wilberforce College, Hull and Dr Malcolm Swan from Nottingham University. The underlying principles to Malcolm's and Susan's approaches are identical, and built on research evidence of the last 30-40 years, which suggests that learning mathematics is far more successful if learners are actively engaged, encouraged to think mathematically and to see links and connections. They also accord with the findings of the Inspectorate, in relation to good practice. The approach was also adapted for low attaining learners as the 'Thinking through Mathematics' materials in the post 16 phase.

The *Millennium Mathematics Project* (MMP) is a maths education and outreach initiative for ages 3 to 19 and the general public. The MMP is a collaboration between the Faculties of Mathematics and Education at the University of Cambridge, and is active nationally and internationally. The focus is on increasing mathematical understanding, confidence and enjoyment, enriching everyone's experience of mathematics, and promoting creative and imaginative approaches to maths. The project consists of a family of complementary programmes, including the very successful NRICH website, Plus online mathematics magazine, and face-to-face work with schools and the public.

A particularly successful intervention in both mathematics and science, which had a strong theoretical basis was CASE and CAME (*Cognitive Acceleration in Science/Mathematics*). These interventions were among the relatively few projects which could demonstrate a significant impact on the attainment of the learners who participated (indeed the interventions also appeared to have an impact on the attainment of learners in subjects such as English).

Cognitive Acceleration is a method for the development of students' general thinking ability (or general intelligence) which has been developed at King's College, London, in a series of research and development programmes continuing from 1981 to the present. Originally developed for science departments in secondary schools (CASE: 'Cognitive Acceleration through Science Education'), the methods have now been extended to other subjects and to younger children.

All Cognitive Acceleration programmes are rooted in the cognitive psychology of Jean Piaget and Lev Vygotsky, from which has been derived a teaching approach which challenges students' current level of thinking, which encourages the social construction of knowledge (students making knowledge co-operatively), and which encourages 'metacognition' - students' reflection on their own thinking and problem-solving processes. Over many years of rigorous evaluation, it has repeatedly been shown that Cognitive Acceleration has substantial, positive effects on students' cognitive growth, and subsequently on their academic achievement. Each of the programmes has a set of

curriculum materials, but the secret of their success lies in the pedagogy - that is, the way that the teacher uses the materials. For this reason, the effective use of Cognitive Acceleration methods depends heavily on the adequate professional development of teachers.

Every Child Counts (ECC) helps schools to raise achievement in mathematics through support for children who find mathematics difficult (https://everychildcounts.edgehill.ac.uk/). It is run by Edge Hill University on a not-for-profit basis, with support from the Department for Education. 2,183 schools took part in ECC in 2012-13, supporting approximately 23,000 children. Local ECC Providers give training and support to schools.

National Numeracy is an independent charity that focuses on adults and children with low levels of numeracy (http://www.nationalnumeracy.org.uk). Founded in 2012, the work of National Numeracy will be carried out in collaboration with, and support from, key partner organisations and funders.

Successful outcomes include the increasing numbers of students taking advanced mathematics qualifications post-16, although universities continue to complain about the numeracy levels of students studying STEM subjects.

Projects concerning low achievement in France

There are local initiatives regarding low achievement in mathematics and in science in France, but a national coordination of local initiatives does not exist.

The project "*Development of a scientific culture, equal opportunities*" (http://ife.ens-lyon.fr/sciences21), for example, is a local initiative aimed at identifying solid didactical situations to engage students in a scientific learning.

There is no specific mechanism for the management of difficulties of science students. The approach to science education is more comprehensive, and aims at the success of all students by renewed efforts by introducing new approaches based on investigation.

The National Program "*Accompagnement en sciences et technologies à l'écoile primaire (ASTEP)*" is in tune with these objectives (http://www.fondation-lamap.org/fr/astep). It, in fact, aims to support Science teaching in primary schools with external stakeholders (researchers, engineers, PhD students...).

Focusing on the implementation of inquiry-based approaches, the mission of these stakeholders concerns mainly the introduction and explanation of knowledge and scientific know-how.

In order to develop inquiry-based learning at school, ASTEP promotes a system where the research scientists, engineers, professional technicians, and science students commit themselves to actively support primary school teachers and their pupils.

Professional scientists and science students can indeed make key contributions to teaching: being both actors and witnesses of today's science, their everyday lives offer stimulating and living examples. Over the last few years, more and more ways have been made available for them to facilitate teaching on the primary school level, ranging from support in the very classroom to teachers training or resources production.

However, no special attention is given to low achievers in science in this program.

Projects concerning low achievement developed in Germany

Different research projects developed studies and initiatives concerning low achievement in mathematics/science.

Mathe sicher können (Secure competence in mathematics), for example, is a project by the universities of Dortmund, Freiburg, Berlin and Münster, aimed at developing lesson structures, concepts and materials for low achieving students in mathematics in grades 3-7. Since difficulties in the understanding of basic mathematical ideas are a main indicator for problems with mathematics in secondary school, the project focuses on basic competences in order to support cumulative and meaningful learning. For each competency the material includes a pencil and paper test for the diagnosis of the student's level of understanding (class test) as well as supporting tasks, which can be worked on individually, within small groups, or the whole class.

The *SINUS* (Increasing Efficiency in Mathematics and Science Education) is a program designed by the Bund-Länder-Commission for Educational Planning and Research Promotion in 1997 and accompanied by the University of Bayreuth (www.sinus-transfer.eu). The central idea of SINUS is for teachers to work together in regional associations of schools (school groups), which are supported by scientific coordinators. During the development and trial of materials for lessons, the school groups secure a constant reflection and evaluation of each teacher. Since the teachers integrate the innovations for their lessons individually or in small groups into existing teaching concepts, a sustainable change in the teaching culture is more likely. SINUS includes eleven modules, which describe the program's elements, for example cooperative learning, learning from mistakes, developing a task culture or gaining basic knowledge. This enables teachers to flexibly change and develop their own lessons using one or more of the modules and the sets to choose key aspects of their cooperation according to their strengths. In regard to low achievement, two of the program's modules are of importance. The module "gaining basic knowledge" aims towards an individual support in order to prevent the students from feeling overstrained or not exerted at all. This could lead to a loss of motivation and reduce the learner's achievement. Therefore, the chosen tasks should allow to be approached on different levels of understanding. In the module "progress of competencies" it is stressed that way too many students and parents focus on a formal success in tests rather than an increase in understanding. The program tries to turn away from imparting only factual as well as expert knowledge and towards a building of competences. SINUS tries to differentiate between learning and testing situations. What is more, the exercises in a test are to be adapted to the idea of reflecting a student's competences. This is achieved by using open assignments to allow individual strategies, asking the students to reflect as well as describe and reason about their approach (Prenzel, 2000).

Another project aimed at raising students' achievement in mathematics is the *Co^{2}CA* project (*Conditions and Consequences of Classroom Assessment*, 2007-2010), aided by the German research foundation and aimed at studying how performance tests and performance feedback can be designed in mathematics lessons in order to create possibilities for a precise and detailed diagnosis of student's achievements as well as to have a positive effect on future learning processes. The project focuses on information and individual feedbacks, which should support the learners in reducing the gap between their current proficiency level and the learning aim of the assignments by showing them how to achieve that aim. Different types of feedback were tested in a laboratory situation, revealing that feedback, which is oriented on the solving process, is perceived as competence supportive by the students and has a positive influence on the quality of the solving process of mathematical tasks. In the final phase of Co^{2}CA, in 2010/2011, a study took place in 40 ninth grade classes (Realschule). The first sightings of the videos and written feedback show that teachers, who had an intensive training beforehand, were mostly able to implement the idea of formative assessment in the context of a competence oriented mathematics class (Besser et al., 2011).

The KOSIMA project (*Kontexte für sinnstiftenden Mathematikunterricht – contexts for meaningful mathematical learning*, Hußmann et al., 2011) aims at designing teaching-learning-arrangements for a complete middle school curriculum (grade 5 to 10) and empirically researching the teaching-learning-processes and their conditions. The developed curriculum is published as the textbook "*Mathewerkstatt*" from 2012 to 2017 (Leuders et al., 2012) and a comprehensive teachers' manual.

Every teaching-learning-arrangement (each for 2-6 sessions) is structured into four main phases: activation, exploration, organization of knowledge and practice and allows working on different levels, with different approaches and methods.

Projects concerning low achievement developed in Ireland

At present the current Junior Certificate examination is being phased out and replaced by a school-based approach to assessment. *Junior cycle assessment*, both formative and summative, will be school-based and focus on supporting learning. School-based assessment emphasises both the process and the product of learning in school through the combination of students' work and final assessment. This approach will ensure that assessment takes place as close as possible to the point of learning. Final assessment at the end of a period of study has a role to play, but it will be just one element of a broader school-based approach to assessment.

Also the National strategy "*Literacy and Numeracy for Learning and Life"* aims at addressing significant concerns about how enabling students to develop the skills that they need as regards Literacy and Numeracy.

Another National program concerning the improvement of students' Mathematical competences is the initiative "*Project Maths"*, quoted by the report *"European Mapping of initiatives on the development of key-competencies"*.

This initiative was developed by the National Council for Curriculum and Assessment (NCCA), after a review of post-primary mathematics education in 2007, in order to enable the implementation of syllabus change in mathematics over a four-year period from September 2008. This change involved the review of mathematics syllabuses at both junior cycle and senior cycle and a complete change in the approach to the teaching and assessment of mathematics, now focused on allowing students to learn mathematics by thinking mathematically, particularly in concrete, real-life situations. The Project Maths initiative placed teachers at the centre of the curriculum development process, since their experiences and feedback informed refinements and subsequent revisions of the curriculum, which was mainstreamed in all Irish schools in 2010.

Discover Sensors programme (www.discoversensors.ie), which represents a partnership between Discover Science and Engineering, the National Centre for Technology in Education (NCTE), the National Council for Curriculum and Assessment (NCCA), the Education Centre Network, and ICT Ireland (IBEC), is another initiative aimed at promoting inquiry-based science teaching and learning with Junior Certificate science teachers. Formative assessment methods and tools form a major part of this programme. Assessment booklets have been developed which seek to inform the teacher (and student) of the student understanding for all of the junior certificate science topics.

Another program, which was specifically focused on the role played by teachers as strategic national resources, is "*Teaching and Learning for the 21st Century*", a school-university initiative drawing together teachers and senior school leaders from second-level schools across Ireland. The programme, which involves 35 post-primary schools, is currently working in partnership with five Education Centres – Co. Wexford, Kilkenny, Laois, Monaghan, Sligo – and with Dublin & Dún Laoghaire Education and Training Board. Its main aims are to enhance teachers' capacities to critically analyse their teaching, therein nurturing a focus on those forms of teaching which are innovative in the context of the 21st century and to encourage students to become more active and responsible participants in their own learning.

Projects concerning low achievement in Italy

The *National Plan for Quality and Merit* (PQM PON) is a program designed to raise students' achievement both by providing lower secondary schools teachers of Italian and Mathematics with training 'on the job' and by organizing remedial and extra classes outside the normal scheduled activities for students.

The program was developed as a consequence of the results of different international surveys, which highlighted a gap between the Italian school system and that of other OECD countries. Moreover, both these international surveys and the INVALSI reports from the most recent National assessment showed a further gap between Italian Northern and Southern areas and that this divide increases starting from the end of primary school. For these reasons, the program was addressed to disadvantaged lower secondary schools of four Southern regions eligible to benefit from EU Regional Development Funds and from the European Social Fund: Campania, Sicilia, Calabria and Puglia. The applicant schools were enrolled giving preference to those performing at the lower end of the distribution according to the percentage of repeating and failing students and dropout rates.

The program, developed in the period 2007-2013, acted in two directions: increasing the number of hours of schooling and involving the teachers in training processes aimed at providing them with innovative teaching materials. Each school involved in the PQM program selected two teachers, who attended training activities for about 60 hours (30 hours of formal training and 30 hours online), set up a plan to be implemented in their sixth grade classes and then experimented the planned activities both during regular school time and during extra classes in the afternoon. Each activity included 15 hours of remedial education for small groups of students to be held in the afternoon. Students were tested both at the beginning and at the end of the school year through the standardize test taken by all the sixth graders in the country.

Another project developed thanks to the PON funding is "*PON SOS-studenti*", aimed at fostering the constitution of an e-learning environment designed to help especially low-achieving upper secondary students in mathematics, Italian, physics, and English. The students are involved in individual e-learning remedial paths aimed at making them reach the disciplinary objectives. The main aim of the project is to enable the development of a vision of learning objects as flexible customisable materials, developed by teachers and usable in different learning contexts. Another objective is to overcome the idea of e-learning materials as a series of gradual exercises with feedback, fostering a multi-faceted education, characterised by communication and exchange.

M@t.abel is another national project concerning the training of mathematics teachers in order to improve the teaching of mathematics in school and thus decrease the deficit on mathematical skills of Italian students detected by the research studies carried out by the OECD-PISA. The project exploits a platform to foster the sharing, discussion and debate between the teachers involved in the project and their tutors. The teachers are trained on the following themes: educational objectives and content of the training materials of the Platform; methodology of e-learning and use of the platform.

Another problematical aspect, highlighted in the last few years in Italy, is the constant decrease in the enrolment of secondary students in tertiary scientific education. The project *PLS* ("*Progetto Lauree Scientifiche*"-Scientific Degrees Project) aims at addressing this problem, involving students in laboratorial activities to enhance knowledge of science contents and improving competences of in-service teachers on laboratory activities focusing on both content and methodological aspects.

The project aims to offer upper secondary school students the opportunity of reflecting on the problem and procedures that characterise the scientific disciplines, verifying and consolidating their knowledge in relation to the skills necessary to face specific University courses.

Moreover, since these opportunities could be given only through the collaboration with schools and teachers, the project is also focused on teacher education, with the aim of enabling teachers to refine their disciplinary and inter-disciplinary knowledge.

Other projects have been developed at a Regional level to raise students' achievement in Mathematics. *EMMA* and *EMERMAT* (both acronyms for "Emergenza Matematica"-Mathematical Emergency), for example, are projects carried out by two Regional Education Agencies (Emilia Romagna and Liguria) to sensitise mathematics primary and secondary school teachers on the critical elements in students' learning revealed by International and National standardised assessments. The project EMMA involves teachers who teach mathematics in the last two years of primary school and in low secondary school. The project EMERMAT involves also teachers who teach Mathematics in the first two years of upper secondary school.

Both the projects are aimed at enabling teachers to reflect on students' results in the national standardised tests, focusing on the conceptual frames and fostering new teaching methodologies. These objectives are pursued through the training of junior and senior tutors, who meet the teachers in their schools to develop with them an in-depth analysis of the standardised tests and on the criticalities in students' Mathematical learning highlighted by these tests.

Another regional project focusing on research, innovation and professional development in the field of school self-evaluation is *AVIMES* (Autovalutazione d'Istituto per il Miglioramento dell'Efficacia della Scuola-Institute Autoevaluation for Improving School Efficiency, http://www.avimes.it). The project has been developed since 1998, when a group of primary and lower secondary schools of the Turin area, in close collaboration with the Inspectors Office of the Regional School Authority (Regione Piemonte), started using achievement tests and questionnaires, prepared with the advice of experts, with the aim of finding out schools' strengths and weaknesses as a starting point for improving school quality.

The information gathered is stored in a database, which is periodically updated and can be used for: internal and external reporting, improving school organisation, refining the curriculum planning, improving the quality of classroom practice, fostering the professional development of teachers and school-heads. One of its products is a catalogue of tests for diagnostic and formative assessment of students' mathematics competencies (grades 1-6).

Projects concerning low achievement developed in the Netherlands

Several initiatives have been carried out at National level in the Netherlands to raise students' achievement. Some of them are specifically focused on low achievers. The *Passende Perspectieven* (Appropriate Perspectives), for example, is a National project aimed at providing assistance with the design of remedial education, developing curricular materials for students who do not attain the most basic level 1F.

Other projects are mainly focused on Mathematics, such as:

a) *Speciaal Rekenen* (Special Arithmetic), commissioned by the Ministry of Education and aimed at designing a large number of tools and products to support teachers in the introduction of realistic arithmetic (http://www.fi.uu.nl/speciaalrekenen/);
b) *Mathchild*, an interlinked research project whose general objective is to study the development of children's mathematical skills, identifying the developmental pathways for children's proficiency and deficiency in mathematics (http://vu.mathchild.nl/);
c) *Language-based support in Mathematics Education*, a project aimed at investigating how scaffolding in mathematics education can be facilitated, focusing on the teachers' linguistic support (http://www.nwo.nl/onderzoek-en-resultaten/onderzoeksprojecten/25/2300185325.html);
d) *Impulse* project (Inquiring Mathematical Power and Unexploited Learning of Special Education students), a research project whose main objective is to investigate the mathematical potential

of special education students through new assessment approaches that offer students opportunities to show what they are able to do (http://dspace.library.uu.nl/handle/1874/255569);

e) *Every child deserves differentiated (special) math education*, a project that aims at identifying relative merits of convergent and divergent differentiation in various grades of elementary school (http://www.nwo.nl/en/research-and-results/research-projects/80/2300167180.html);
f) *Differentiation in mathematics classrooms in vocational education*, aimed at investigating the merit of internal convergent differentiation in vocational education (http://www.nwo.nl/en/research-and-results/research-projects/77/2300185377.html);
g) *Mathematical thinking in practice*, project developed to investigate the mathematics problems that stimulate mathematical cognition (http://www.nwo.nl/onderzoek-en-resultaten/onderzoeksprojecten/28/2300185328.html);

Finally, other projects address the problem of analysing the results of periodical national assessment:

a) *Periodieke peiling van het Onderwijsniveau* (PPON-periodical assessment of educational level), which aims at developing studies that enable teachers and policy makers to compare performance levels across time in order to assess educational quality and time-based trends in performance of large groups of students (http://www.cito.nl/Onderzoek%20en%20wetenschap/deelname_nat_onderzoek/ppon.aspx);
b) *Vergelijkingsonderzoek referentiesets* (comparative study reference sets), whose objective is to make it possible to assess to what extent students have achieved the recently distributed aims formulated in levels 2 and 3 F and S (toetswijzer.kennisnet.nl/html/referentiesets/default.shtm).

Projects concerning low achievement developed in Norway

Following the PISA and TIMSS results, a lot of discussion and national initiatives have been developed in Norway to enhance the mathematics and science competence of pupils at all school levels. Several government documents and white papers that address pupils' achievement in school have been issued ("Motivasjon – Mestring – Muligheter" in 2010-2011, "Learning together" in 2010-2011, "Mangfold og mestring" in 2010, "Rett til læring" in 2009; "Science for the future. Strategy for Strengthening Mathematics, Science and Technology" in 2010–2014) and national initiatives have been developed with the aim of engaging young people in science and mathematics, in the hope that pupils achievement and understanding will improve.

FYR, for example, is a Norwegian government's initiative to raise the relevance of schools subjects and decrease the high dropout rate from upper secondary schools, particularly in the vocational studies. *Lektor 2* is another national initiative aimed at raising the relevance of mathematics and science (including Design and Technology) in lower and upper secondary education by inviting professionals and experts from the world of work to take part in the teaching of these subjects.

Finally, the *Role model* project enables people working in maths and science related fields to visit schools and tell students about their work and which possibilities a scientifically related career offers.

In addition, several regional, national or international research projects, focused on science and mathematics, have been performed in Norway. The *Budding Science and Literacy* project, for example, aims to study how the interplay of indoor and outdoor inquiry-based science activities and inquiry-based literacy activities can improve teachers' instructional competence and students' learning outcomes in science over time.

Other projects aim at raising the number of students who decide to pursue an education in STEM (science, technology, engineering and mathematics). The *Vilje-con-valg project* (Lily project), initiated by the Norwegian Centre for Science Education and the Department of Physics (University of Oslo) in 2008, aims at developing new knowledge and theoretical perspectives, and to stimulate informed discussion, of how to recruit and retain more young people in science, technology, engineering and mathematics (STEM) careers.

The *IRIS* ("Interests and recruitment in science") project share similar aims, addressing, in particular, the challenge that few young people in general, and women in particular, choose to pursue an education in STEM. The objective of IRIS is to develop knowledge and recommendations informed by evidence on how these categories of people may come to see STEM as an educational choice that is right for them and to persist in their STEM education until graduation.

Finally the *ROSE* (the Relevance of Science Education) project, developed at the international level, is meant to shed light on affective factors of importance to the learning of science and technology. The project aims at providing a base for informed discussions on how to improve curricula and enhance the interest in science and technology in a way that respects cultural diversity and gender equity, promotes personal and social relevance and empowers the learner for democratic participation and citizenship.

Projects concerning low achievement in South Africa

There are many non-governmental organizations and institutes linked to universities that implement local and regional initiatives addressing low achievement in mathematics in South Africa. AIMSSEC (African Institute for Mathematical Sciences Schools Enrichment Center) is one such institution. Initiatives include extra classes for learners and professional development for teachers.

One wide-ranging regional initiative is the broadcasting of lessons by experienced teachers to schools across one province. The provincial education department identified suitable teachers and a local university provided the infrastructure to broadcast the lessons. The lessons are aimed at learners in Grade 12 and mathematics is one of the subjects taught.

On a national level, the DBE has reported on a set of interventions aimed at the school system as a whole. The *General Education System Quality Assessment Country Report* (2013) outlines these:

"Three major initiatives aimed at improving quality in the poorly performing part of the education system were introduced in 2011: The Annual National Assessments, the Curriculum and Assessment Policy Statements and the national workbooks initiative."

The numeracy component of the ANAs is a national initiative to identify low achievement in mathematics as a first step in supporting teachers and learners to improve in mathematics.

The *Curriculum and Assessment Policy Statements* (CAPS) is another national initiative. One of the major issues addressed through its implementation is the limited extent to which the curriculum is covered by most teachers. To address this, the CAPS specify what topics need to be covered each term and how much time is to be spent on each topic. One consequence of this is that teachers are required to move on from topic to topic week by week whether the learners understand the concepts or not.

In 2013 the government also implemented a new procedure for the publishing of textbook. Previously schools could select from any of the textbooks that were published but currently textbooks are assessed before publication and only those deemed "CAPS aligned" are published. These textbooks all specify what need to be taught each week.

As mentioned above, a major concern in South Africa is that teachers omit large parts of the curriculum. The *national workbook initiative* was implemented in 2013 and aimed to ensure that

teachers cover more of the curriculum, as can be seen in this quote from the introduction to the workbooks: "The Rainbow Workbooks form part of the Department of Basic Education's range of interventions aimed at improving the performance of South African learners in the first six grades... We hope that teachers will find these workbooks useful in their everyday teaching and in ensuring that their learners cover the curriculum. We have taken care to guide the teacher through each of the activities by the inclusion of icons that indicate what it is that the learner should do".

This initiative has had some problems, however. The first edition of the workbooks was full of errors, which have not been corrected in the second edition. There are also some districts in which teachers have been told to use the workbooks exclusively (i.e. not to use textbooks) where the original intention of the workbooks was to provide an additional resource and not to be the primary resource.

Comparative analysis of the of the National or Regional projects/studies/initiatives concerning low achievement (especially in Mathematics and Science) in the FaSMEd countries

The analysis of the different projects/studies/initiatives developed in the FaSMEd countries to raise students' achievement and motivation in the study of mathematics and science enabled to identify different categories of projects/studies/initiatives, according to their main aims, which are:

a) To develop different kinds of materials for low-achieving students;

b) To share innovative materials with teachers / To foster teachers' reflections on the teaching and learning processes;

c) To improve the teaching of science;

d) To improve the teaching of mathematics;

e) To raise students' achievement improving school standards or teachers' implementation of the curriculum;

f) To foster new assessment strategies to support learning;

g) To analyse affective factors;

h) To enable specific categories of people to see science, technology, engineering and mathematics (STEM) as an educational choice for them;

i) To raise the relevance of mathematics and science;

j) To decrease high dropout rate.

The results of this comparative analysis are summarised in Table 3 (reported in Appendix).

D2.1.4 Outcomes

Introduction to this theme

Identifying the strengths and weaknesses of the pathways for low-achievers available in the FaSMEd countries and investigating the range of effectiveness of the different projects developed to raise students' achievement is an important step to identify the effective strategies to support low achievers and also the problematical aspects that should be faced.

As regards to this theme, there is a general lack of information within European countries, as denounced in the Eurydice Report "Mathematics Education in Europe":

> *"Overall, it appears that there is a marked need to collect and systematically use robust evidence on effective intervention and support. Another important finding of the analysis of national information is the need to improve the monitoring and evaluation of measures to address low achievement as only a handful of countries have recently conducted evaluations of the impact of support programmes"* (p.92).

In order to identify what kind of results have been already highlighted, national and international surveys and reports related to this theme have been analysed.

In particular, the main objectives of this analysis are:

(1) to compare students' performance in mathematics and science, in the partners countries, in the last PISA 2012 and the performances in the previous PISA 2009 and PISA 2003;

(2) to compare the shares of low performers to that of top performers, within the partners countries, in PISA 2012;

(3) to highlight the percentages of resilient students (those who beat socio-economic disadvantage and performing at the highest levels) within the partners countries;

(4) to identify the obstacles to the implementation of measures to tackle low achievement;

(5) to identify the strengths and challenges to the different approaches to evaluation and assessment;

(6) to highlight the impact of the typical pathways for low-achievers available within the FaSMEd school systems and the results of specific initiatives aimed at raising students' achievement developed within these countries.

As regards the objectives (1), (2) and (3), the main sources of reference were the "Country Notes" of "PISA 2012 Results", available for France, Germany, Italy, Norway, and UK.

The identification of the obstacles to the implementation of measures to tackle low achievement (objective 4) has been developed through the analysis of the Eurydice reports "Mathematics Education in Europe" and "Science Education in Europe".

Finally, the OECD document "Synergies for Better Learning. An international perspective on evaluation and assessment" (2013) was the source of reference to analyse the strengths and challenges to the different approaches to evaluation and assessment and Policy priorities (objective 5). All these aspects will be presented in the next three sections.

A specific section will be also devoted to the presentation of the available results about the outcomes of both the typical trajectories for low-achievers in the FaSMEd countries and the specific National initiatives aimed at raising students' achievement (objective 6). These aspects were highlighted through the analysis of the available National Reports and research papers on this theme.

Students' performance in mathematics and science in PISA 2012: comparison to the previous PISA 2009 and PISA 2003, shares of low-achievers and resilient students

With regards to the performance in mathematics, on average across OECD countries with comparable data, between 2003 and 2012 there was an increase of 0.7 percentage points in the share of students who do not meet the baseline proficiency level in mathematics and a reduction of 1.6 percentage points in the share of students at or above proficiency Level 5.

With regards to the performance in science, the PISA 2012 reports highlights that, across OECD countries, 18% of students perform at or below Level 1 (13% perform at Level 1 and 5% perform below Level 1).

However, in the both the mathematics and science "PISA 2012 results" reports, it is observed that these trends vary across countries.

The reports group countries into three main categories:

(1) the first category refers to those countries which have simultaneously reduced the share of low performers and increased the share of top performers between previous PISA assessments and PISA 2012;

(2) the second category refers to the countries where the share of low performers has been reduced, but the share of top performers has not been increased;

(3) the third category refers to countries which increased the share of top performers but not reduced the share of low performers;

(4) the fourth and last category refers to the countries where the share of top performers has been reduced or the share of low performers has been increased.

In both the reports it is stated that, from a trends perspective, countries succeed when they reduce the share of students who perform below proficiency Level 2 (low performers) or when they increase the share of students who perform at or above proficiency Level 5 (top performers) as they provide more opportunities for students to begin to show scientific or mathematics literacy or to have the highest level competencies in science or mathematics.

The countries that have reduced the proportion of students scoring below Level 2 and increased the proportion of students scoring above Level 5 (category 1) are those that have been able to spread the improvements in their education systems across all levels of performance. As regards the performance in mathematics, Italy and Ireland belong to this category. Italy belongs to this category also in relation to students' performance in science.

The countries that saw significant improvements in the performance of students who previously did not meet the baseline proficiency level, but no change in the proportion of students scoring at or above Level 5 (category 2) have enabled the students who need it most to develop basic skills and competencies to fully participate in society. Germany belongs to this group, as regards students' performance in mathematics, while Ireland saw a reduction in the share of students performing below proficiency Level 2 in science.

According to the PISA 2012 report, belonging to category 3 - that is having been able to nurture top performance without fostering change in low performers' results – signals a school system's capacity to promote student performance at the highest level.

Norway is among the countries belonging to category 4. In fact, the highlighted decline in students' mean performance in mathematics seems to be related to an increase in the share of low performers since 2009, while the share of top performers has remained stable. Also the share of low performers in science has significantly increased since 2009.

The country reports of "PISA 2012 Results", available for most FaSMEd countries (France, Germany, Italy, Norway, Netherland, and UK), enable us to highlight peculiarities of these school systems, concerning regional differences, different uses of student assessments, percentages of resilient students, equity in the distribution of resources, levels of between-school variation in performance, levels of mathematics anxiety.

The French country report, for example, has highlighted a decrease in the mathematics performance between PISA 2003 and PISA 2012 that made ***France*** be inserted among those countries which are below the OECD average. On the contrary, the science performance, which is stable, is at the OECD average. The percentages of high-performing and low-performing students are, respectively, 13% and 22%, at the OECD average.

Other peculiar aspects highlighted by the country report are:

(a) A strong correlation (higher than in most OECD countries) between the socio-economical background and the students' performance strictly connected to the observed decrease in the mathematics performance;

(b) A proportion of resilient students (22%) that is below the OECD average (26%);

(c) A more unequal school system than it was before

(d) A high proportion of students who are not confident of their mathematics skills and not perseverant while solving mathematics problems.

The German country report shows that students perform above the average in both mathematics and science. As highlighted before, ***Germany*** reduced its share of low-achievers in mathematics by almost 4 percentage points, while share of top-performers has not changed significantly over time. Also in science the percentage of students who do not achieve the baseline level of proficiency (12%) is below the OECG average (18%).

Other peculiar aspects highlighted by the country report are:

(a) A large performance variation between schools, which reflects Germany's multi-tiered secondary school system that tracks students into different types of school based on students' performance (although the number of students who attend schools that combine several types of programmes has increased, the performance variation between and within schools have not changed significantly since 2003);

(b) Raising in the equity levels, corresponding to a weakened influence of socio-economic status on students' performance (the proportion of the variation in students' mathematics performance that could be attributed to differences in students' socio-economic status decreased from 24% to 17% between 2003 and 2012);

(c) An increasing proportion of resilient students;

(d) An increasing proportion of students who attend schools that admit students with diverse academic abilities and a corresponding tendency to group students by ability in some or all classes.

As regards ***Italy***, the country report shows that, although this is one of the countries with the largest improvement in mathematics and science performance, both the mean mathematics performance and the mean science performance among 15-year-olds are still below the OECD average. The report also reveals large regional differences in mathematics performance, with some regions that score well above the OECD average and others scoring below this average.

Other peculiar aspects highlighted by the country report are:

(a) The small proportions of students who attend schools that use student assessments to judge teachers' effectiveness, to compare their school with other schools or that track achievement data over time;

(b) The stability in school equity (the improvement in performance is observed among all socio-economic groups);

(c) The growing in the proportion of resilient students between 2003 and 2012;

(d) The imbalance in the distribution of educational resources between schools with disadvantaged student population and schools with a more advantaged student population;

(e) The tendency of having above-average levels of between-school variation in Mathematics performance, which implies below average levels of academic-inclusion (two students who attend different schools can be expected to perform at very different levels);

(f) An above-average proportion of students who reported high levels of mathematics anxiety (43% of students reported that they feel helpless when doing mathematics problems).

According to the ***Norwegian*** country report of "PISA 2012 results", Norwegian students perform around average in mathematics, but below average in science. Although the performance in mathematics did not change significantly since 2003, the mean performance declined since the previous PISA assessment in 2009. The share of low performers in mathematics is close to the OECD average, while the share of top performers is below that average.

Other peculiar aspects highlighted by the country report are:

(a) An above-average percentage of resilient students;

(b) An increased level of equity since 2003, when a higher percentage of the variation in student performance in mathematics was attributed to differences in students' socio-economic status;

(c) A close to the average proportion of students who report low levels of enjoyment in mathematics;

(d) The third highest spending on education among OECD countries.

The **UK** country report of "PISA 2012 results" highlights that the students' performance in Mathematics is at the OECD average in the United Kingdom. Also the proportions of top performers and low performers are similar to the OECD average. On the contrary, the performance in science is above the OECD average, together with the proportion of top performer, while the proportion of low performers is below the OECD average.

(a) A percentage of resilient students similar to the average across OECD countries;

(b) Equity in education outcomes at the OECD average (but UK is less successful than other countries in reducing the influence of socio-economic status on student performance);

(c) A low percentage of students who report high levels of mathematics anxiety;

(d) Same level of performance in mathematics between students from an immigrant background (first or second generation) and other students, in contrast to the situation observed in many other OECD countries, where students from an immigrant background score significantly lower.

Obstacles to the implementation of measures to tackle low achievement

Both the Eurydice reports "Mathematics Education in Europe: Common Challenges and National policies" (2011) and "Science Education in Europe: National Policies, Practices and Research" (2011) discuss the implementation of measures to tackle low achievement.

In the "Mathematics Education in Europe" report it is stated that, in the majority of European countries, central education authorities prescribe or recommend measures, or give assistance to teachers and schools to address low achievement in mathematics. The measures may range from compulsory national programmes to support for a limited number of activities. Some countries propose measures that are applicable to all students in the classroom, including different teaching methods such as differentiated learning and contextualisation. Others focus mainly on low-attaining students and encourage prevention, early diagnosis and individual interventions. In some countries

the design and implementation of measures to tackle low achievement are left entirely to the discretion of teachers, schools and school providers and only in few countries specialised teachers or assistants who can help classroom teachers to support low-achieving students are available.

As regards the science subjects, the "Science Education in Europe" report states that no European country has implemented a specific policy to address the needs of low achievers. The help for low achievers - which could range from differentiated teaching, one-to-one tuition, peer-assisted learning, tutoring and ability grouping - is usually provided as part of a general framework of support for pupils and students which applies to all subjects.

The "Mathematics Education in Europe" report suggests that the measures taken to address low achievement could really be effective only if they are embedded in curriculum content, classroom practices and teacher education and training.

Among the possible obstacles to the organization and implementation of these measures, the report includes the inadequate resources that are provided, the lack of appropriate diagnostic tools, the difficulties in selecting subject topics for intervention and the insufficient teacher qualifications and skills. Moreover, the report denounces that few countries have established national targets to reduce the numbers of low achievers in mathematics. Another important constraint is the lack of sufficient evidence on the impact of factors such as duration, starting time, intensity, type of assessment and qualifications, and type of the teaching staff involved is available. Therefore there is a need for longitudinal studies that could help to highlight the advantages and effectiveness of specific forms of support and the long-term benefits of interventions.

Strengths and challenges to the different approaches to evaluation and assessment

In the OECD document "Synergies for Better Learning. An international perspective on evaluation and assessment" (2013) policy priorities connected to evaluation and assessment are identified:

1) to take a holistic approach, that is to enable the various components of assessment and evaluation to form a coherent whole, preventing inconsistency of objectives;
2) to align evaluation and assessment with educational goals;
3) to focus on improving classroom practices and student learning;
4) to avoid distortions, that is minimising the side-effects of the role played by evaluation and assessment on how and what students are thought;
5) to put students at the centre, engaging them with their learning and empowering them to assess their own progress;
6) to monitor broader learning outcomes, including the development of critical thinking, social competencies, engagement with learning and overall well-being;
7) to build capacity at all levels, fostering, for example, the training of teachers in formative assessment.

"OECD of Evaluation and Assessment in Education" and Country background reports are available for Norway, Netherlands, Ireland and France. In these documents strengths and challenges of the different assessment approaches are discussed and potential future directions are suggested.

As regards ***Norway***, the main suggestions for policy makers are:

a) to develop clearer and more visible learning goals and criteria to guide student assessment;
b) to reinforce consistency and fairness in assessment, reporting and grading;
c) to strengthen coherence and clarity about purposes and uses of different assessments;

d) to continue to support formative assessment in schools, with particular focus on feedback and student engagement;
e) to further support focused professional learning on effective student assessment.

In the document on evaluation and assessment in the ***Netherlands***, it is stressed that the Dutch approach has many strengths. However, some directions for future policy development are suggested:

a) to embed the evaluation and assessment framework with broader education goals;
b) to further develop and integrate the evaluation and assessment framework;
c) to continue to build on teacher professionalism;
d) to engage stakeholders and build networks for system-wide learning;
e) to build capacity for effective and forward-looking evaluation and assessment.

In the Irish country background report, it is observed that, while there are positive elements in relation to assessment practice in ***Ireland***, there is scope for further development in terms of the implementation of key aspects of the assessment policy framework such as effective use of assessment as a formative tool and systematic reporting of assessment information to parents.

The document also reports of some weaknesses, highlighted through the Inspectorate evaluations, in relation to the implementation of students assessment at primary level, such as the dependency on the informal use of teacher observation as an assessment tool, the limited focus on learning priorities and outcomes, the limited use of assessment modes to provide information on the outcomes of learning, and the limited use of assessment data for formative purposes. Moreover it is observed that standardised assessment appears to operate as a stand-alone activity in many primary schools, and assessment data seems to be regarded more as a record of pupils' attainment rather than as a means of informing ways to improve and support their learning.

As regards the secondary level, the document testifies the ongoing national debate on the current approaches to assessment, despite the credibility retained by the examinations systems. A specific concern highlighted by this debate is the adequacy of the examinations system in terms of assessing the skills that students need for the future. Other problematical aspects that have to be discussed are the pressure that the high stakes Leaving Certificate puts on students and the proportionately small numbers that take science subjects or mathematics at a higher level in the State examinations.

The reports finally denounces that the implementation of formative assessment is at an early stage of development in Ireland and that, consequently, there is limited use of assessment to inform learning in Irish classrooms.

The **French** background report describes the changes occurred in the tools for students assessment since 2005, denouncing the difficulties faced in the implementation of these tools.

In particular, the document identifies the main difficulties faced in the implementation of the Socle Commun, suggesting that they must be considered in order to improve its effectiveness and the evaluation of its impact on students' learning and on the education system:

a. the notion of competence is relatively new to the teachers, who base their teaching methodologies and assessments more on students' knowledge than on their competencies, therefore further teacher education is needed to enable them to better integrate this notion in their practice;
b. the programmes, within which the Socle Communs has been integrated, and developed by levels, while the Socle is characterised by a cyclic approach; this entails problems of implementation that could be faced through a reorganization of the programmes;

c. the fact that it is not necessary to validate all the items to demonstrate a competence raises a question with regards to the different definitions of competence according to the different stakeholders in education;
d. the lack of external and national evaluation for the final validation of the certificate of competencies raises the question of teachers' neutrality in their judgment.

Main outcomes of the typical trajectories for low-achievers in the FaSMEd countries and of the specific National initiatives aimed at raising students' achievement

As highlighted in the previous sections, there is a general lack of information about the effects and the main outcomes of the different initiatives and programs develop to address low achievement. Only a few countries have conducted evaluations of the impact of these initiatives.

The Ofsted's report "*Mathematics: made to measure*" (2012), commissioned by the British Office for Standards in Education, Children's Services and Skills, represents an example of these evaluations and therefore enables to highlight the main outcomes of some important initiatives carried out in England.

First of all the report discusses the strategy of using assessment data to track pupils' progress and of frequently monitoring the quality of teaching through a wider range of activities. The report states that, on one hand, this strategy enabled a robust challenging of weak performance, but on the other hand lacked attention to the mathematical detail. In fact, the data analysis "*was linked to intervention and revision and monitoring focused on generic characteristics rather than pinpointing the subject-specific weaknesses or inconsistencies that impeded better teaching and greater coherence of learning*" (p.7).

Another problematic aspect highlighted by the Ofsted report is that, while pupils working below but close to national expectations were often at the centre of schools' efforts to raise attainment, the pupils working *well below* expectations tended not to be the focus of such attention. Moreover, the report denounces that many schools, feeling the pressure to raise attainment rapidly, tend to concentrate on the best teachers and the main intervention programmes in the priority year groups, instead of improving provision for younger pupils. The report, therefore, suggests that day-to-day provision needs to be improved.

Another important issue raised by the Ofsted's report is related to the strategy of placing pupils in sets for mathematics in Years 8 to 11. Many pupils, in fact, when tested by the secondary school at the start of Year 7, did not reach the levels they had been awarded in the Key Stage 2 test and teacher assessments. As regard to this result, the report suggests that this difference raises questions about how secure aspects of the pupil's learning are in primary school. This could be due to the fact that the set a pupil is placed in determines the mathematics (s)he will encounter and potentially caps what (s)he might attain. In fact, many schools struggle to staff all of their mathematics classes with skilful specialist teachers, and therefore they often choose to prioritise the staffing of key examination classes and higher-attaining sets, placing non-specialist and temporary teachers with lower sets and younger classes or making two teachers share a class, again usually of younger or less-able pupils.

As regards the teaching of science in England, the previous Ofsted's report "Successful Science" (2011) identifies six features which characterise the approaches adopted by the primary level schools where achievement was rising over time: (a) increasingly accurate assessment; (b) a high profile accorded to science in the school; (c) coverage of the full science National Curriculum programmes of study, rigorously monitored; (d) staff who were confident in teaching pupils how to work scientifically; (e) strong links between literacy and science; and (f) very good, regular monitoring of achievement in science for individuals and groups of pupils.

At secondary level, Ofsted inspectors noticed that, although the strategy of increasingly involving students in peer- and self-assessment is developing, the approach should be improved, because students in some classes have not been trained effectively enough in assessing their own and others' work. It could be argued, therefore, that, in general, the interventions to support pupils at risk of underachievement in England tend to be ineffective because they are too generic and fail to focus on the specific learning difficulties of each individual learner.

Another official review of the outcomes of the paths for low-achievers within the school systems has been commissioned *School Inspection* of the Netherlands. In 2008, the School Inspection released a report concerning the quality of education in mathematics and school-based interventions ("*Basisvaardigheden rekenen-wiskunde in het basisonderwijs*", 2008). With regard to the trajectories for children with delays in mathematics performance, they concluded that:

- 95% of the schools used a unitary system of instruments and procedures for tracking the development and performance of pupils with regard to mathematics;
- 66% of the schools decisions about what remedial care is needed were made systematically;
- 70% of the schools the remedial care was provided in a systematic way;
- 60% of the schools the effects of remedial care were evaluated.

The extent to which a unitary system for tracking the development and performance of pupils is used has been positively evaluated, but the review stresses the need of improving the extent to which schools follow systematic procedures when remedial education is indexed.

With regard to the school year 2012/2013, the School Inspection ("*De staat van het onderwijs onderwijsverslag* 2012/2013") concluded that pupils with delays in scholastic achievement often are given extended instruction, and that targeted interventions are often omitted because the extended instruction is considered to be sufficient in remediating these pupils delays by the schools. In case additional remedial care is given, the School Inspection criticises the extent to which remedial care is being evaluated. In 2012/2013, between 65% and 88% of the schools met each individual criterion of quality care, but only 38% of schools met all the criteria.

Furthermore, specific intervention activities of schools are evaluated as follows:

- the percentage of adequate identifications of the pupils who are in need of early care by the schools is 94%;
- the percentage of adequate identification of pupils with special education needs through the analysis of collected data is 59%;
- the percentage of adequate additional care systematically given by schools is 53%;
- the percentage of schools that adequately evaluates the effects of care on a regular basis is 67%.

The identification of pupils in the Netherlands who need care seems, therefore, to be almost completely done in an adequate way. However, in about half of the cases the additional care is not given in a systematic way and, in one third of the cases, the evaluation of the effects of the given care is done inadequately.

A report to evaluate the measures adopted to give help and support to students from primary to high secondary schools was also developed in France (Bouysse et al., 2010).

The report first of all summarises the different measures concerning low achievement in schools, then outlines pictures of the different implementations of the national measures respectively in primary, lower secondary, upper secondary and vocational schools. Finally it proposes an analysis of the functioning of these measures, together with recommendations for the future.

As regards the analysis of the functioning of measured to raise achievement, the report highlights this problematical aspects:

- the recipients of helps are not always those who need it most;
- the expertise of teachers to support students is underdeveloped;
- teachers have difficulties in practicing individualised teaching;
- the lack of an overall coherence and of a collective work of teachers harms the system's efficiency;
- the evaluation of the impact of the measures often is not developed or is only partial.

In the section devoted to recommendations for the future implementation of these measures, it is stressed that the locution "low achiever" includes different meanings and it is possible to consider only the symptoms (results, attitude, absenteeism...) or the causes (command of language, skills, specific troubles as dysphasia, dyscalculia,...); to sum up, low achievers are almost always considered in the point of view of their scholastic efficiency and rarely for themselves as persons.

The report therefore suggests that teachers should be provided with reliable assessment tools, directly related to the programs, and suitable to identify the students' achievement and possible shortcomings. Moreover, teachers should receive methodological supports for the development these assessments.

Other recommendations given in the report concern the need of:

- providing teachers with diagnostic aids to analyse the situation of a student;
- clarifying what is expected of students in terms of language use and raw knowledge of writing at the end of kindergarten,
- working with teachers on assessment methods,
- mobilizing the needed help devices as soon as possible,
- rigorously monitoring the mobilization of resources and ensuring that aid recipients are students who need it most,
- experimenting intensive assistance for students in great difficulties,
- focusing on more qualitative approaches.

In other countries, research studies have been conducted to analyse the effects of specific paths aimed at raising achievement in mathematics or science.

As regards Italy, for example, an evaluation of the outcomes of the national PQM project has become possible thanks to the research conducted by Battistin and Meroni (2013a, 2013b), who highlighted that the role of trained PQM teachers and of increased instruction time through afternoon activities was really significant only in the most problematic learning environments.

In fact, they provided evidence that extra time at school spent doing mathematics activities increases the test score and the percentage of correct answers in mathematics just in schools characterised by lower pre-intervention performances, while no effect is found for treated classes in the other schools. Battistin and Meroni (2013b) interpret this result in this way: the extra time spent at school during the PQM program by students belonging to a lower socio-economic background "*is the only time they dedicate to studying outside regular school time, thus they are actually spending more time on academic activities, which means that achievement works as a cumulative process, and more time at schools results in higher performances, in addition spending more time at school also decreases the "negative" influence of the families, which we assume are not very supportive and helpful for the children in context characterised by low socio-economic background*" (p. 27).

Moreover they showed positive effects of PQM activities for students lying in the middle part of the distribution, a smaller effect for top performing students, while no effect for very low achieving

students. Battistin and Meroni (2013b) suggest that probably, for these last students, extra instructional time is not enough and really targeted interventions focusing just on them are needed.

Finally they found that extra instructional time, held outside regular school time, does not add much in terms of concepts, but it may be very useful in stimulating students' ability to think, use and apply their knowledge.

Other research that highlighted the role played by the activities developed through teachers (quality of educational resources, teachers' shortage, extracurricular activities, etc.) is conducted by Agasisti and Longobardi, documented in a research paper available on the INValSI (National Institute for the Evaluation of Education and Training System) website.

The paper investigates the main characters of "resilient schools", that is the contexts that better help students to become resilient. The paper suggests that future policy measures should promote those activities and dimensions of schools that favour (i) better relationships between students and teachers, as well as (ii) the diffusion of (good) extracurricular activities, together with (iii) the provision of adequate resources for curricular teaching – to avoid teachers' shortage and improving quality of teaching activities. These factors could be useful, in fact, to improve the performance of disadvantaged students. The paper also suggests that the results of the research confirm the necessity to increase the degree of schools' autonomy, as those dimensions on which they are already autonomous (i.e. extracurricular activities) turn out as positively related to the students' performances.

In Germany, research studies have been conducted to identify possible causes related to the difficulties met by low achievers in mathematics and ways to better identify students who need help. There are, for examples, studies showing that the difficulties of low achievers in secondary phase 1 (grades 5-10) can be traced back to problems with the mathematical contents in primary school (Moser Opitz, 2007). Moser Opitz (2007) showed that understanding contents such as the decimal system, unit operations, counting in steps and handling word problems (called mathematical *basic contents*) is a main predictor for the recent mathematical attainment levels in grades 5 and 8. The conveyance concept *SimBa* (Sicher im mathematischen Basisstoff / Being sure about the mathematical basic contents) has been introduced to highlight the need of closing the gaps of the knowledge of low achievers concerning the basic contents of primary school rather than working on recent topics on the secondary level. The evaluation of the intervention within SimBa showed that effective approaches that really help to close these gaps should involve:

a) materials which include possibilities to differentiate and individualise;

b) an initial assessment (as differentiated as possible) aimed at adapting the support materials according to the students' individual needs;

c) interventions planned over a long period of time (14 weeks didn't seem long enough);

d) activities aimed at linking the mathematical basic contents with the recent secondary school contents;

e) support for students in transferring contents to expanding topics (Freesemann, 2013).

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APPENDIX

Table 1: Comparative Analysis about the Identification of low achievers in the FaSMEd countries

	England	France	Germany	Ireland	Italy	The Netherlands	Norway	South Africa
Range of diagnostic tools to identify low achievers	Ongoing formative assessment practised by all teachers. Statutory teacher assessments at the end of key stages: 1 (6-7 years old), 2 (10-11 years old), 3 (14 years old). At the end of key stage 3 (usually age 14) there are statutory testing arrangements based on teacher assessment judgements. Statutory externally set and marked tests at the end of key	Regular assessments made by teachers featured in the "school report book" (primary school); national standardised tests (2nd and last year of primary school, last year of lower secondary school); the personal skills record book that certifies the acquisition of the seven common base skills, from primary school to the end of compulsory education.	Constant monitoring of the learning processes by the use of oral and written controls. Report describing in detail pupils' progress, strengths and weaknesses (first two grades of primary school). At lower secondary school, papers and written exercises are spread evenly over the school year.	Ongoing assessment of students' progress. Standardised tests which provide teachers and parents with objective information on a child's achievement. School-based examinations set by the subject teachers. The Junior Certificate examination, at the end of the compulsory period of education, is an important form of state-certified student assessment.	Recurrent and final evaluation, focused on pupils' learning process and consistent with the learning objectives established in the Plan of the educational offer of each school. Certification of the competencies attained by the pupils at the end of primary school. Standardised assessment. The first-cycle leaving State exam at the end of the third year of	At primary school, pupils' progress is reported usually three times a year. Homework, tests, projects and out-of-school activities are tools for this evaluation. Starting from 2014/2015, it will be compulsory for all schools to use a pupil monitoring system. The Cito (Central Institute for Test Development) primary school leavers' attainment test (year 8) widely used to determine which type of secondary education will be most appropriate for the individual pupil. At lower secondary school,	Continuous formative assessment in the classroom. Six-month evaluations for each subject. Final assessment at the end of lower secondary school. National tests in pupils' basic skills compulsory for pupils at grade 5 and grade 8 in reading, English and Mathematics, and for pupils at grade 9 in reading and Mathematics.	The identification of low-achievement in South African schools focuses more on whole school achievement.

	stage 2 and 4 (16 years old).				lower secondary school	three to four students' progress reports per year are given.		
Role of the National standards in the identification of low achievers	Targets, associated to expected students' performance at key stages, defined by the National Curriculum. Pupils not achieving the targets are regarded as being 'low achievers'. Expectation that all children will be taught and achieve the 'attainment targets' which are contained in the programmes of study.	The "Socle commun" identifies the body of knowledge, skills, values and attitudes that every student must acquire at the end of compulsory education.	Common national educational standards are developed in math and science for specific stages in primary and secondary education. They set out the basic principles for each subject and describe the specific competencies which students should have reached at this stage of their education, outlining the expected levels of achievement.	The Primary School Curriculum outlines the skills that pupils should develop. New framework for Junior Cycle identifies both the specific skills to be developed in each subject and the more general set of skills that are needed to support learners in their personal, social and work lives.	The National Guidelines for the curriculum of the pre-primary school and the first cycle of school education indicate that the general objective of the educational process in the public school system is the achievement of the eight key competences for lifelong learning recommended by the European Parliament.	There is no national curriculum, but the Ministry of Education, Culture and Science sets core learning objectives that students are expected to achieve by the end of both primary and lower secondary education. Reference levels of achievement for language and mathematics have been established, with the identification of fundamental levels that every student should achieve.	The Knowledge Promotion reform introduced a new outcomes-based curriculum covering the entire school system. Competence goals and basic skills goals for key stages of education (Years 2, 4, 7, 10 and each year of upper secondary education) are defined.	The Curriculum and Assessment Policy Statement specifies what needs to be taught each term in each grade for each subject.
Role of National tests as diagnostic tools	Statuary national tests, now only at the end of primary and secondary	National tests in French and mathematics (primary years 2 and 5) allow teachers to measure	National tests are administered at the end of year 9 or 10 to prove that the pupils	For primary school students the performance in standardised tests enables	The National tests of learning in Mathematics and Italian, compulsory for each	The Cito Monitoring System gives scores and sub-scores to the students' performances and	Mapping tests (years 1, 2, 3 and Vg1) to uncover students who need extra help and	Annual National Assessments (in Grades 1-6 and 9), introduced as a strategy to

	education, highlight the learners' progress.	students' learning, detecting problems and identifying possible remedial strategies.	have reached the aims of main stream schooling or for certification purposes. Identification of proficiency levels through the test scores and of risk groups who do not achieve the minimum standards State wide A level exams in 15 out of 16 states.	the identification of low achievers. Knowledge and skills of low secondary school students are assessed in the final examination of the Junior Cycle	school and addressed to students of grades 2, 5 and 10, are only aimed at surveying pupils' learning entering and exiting various education levels. The test for lower secondary schools' third year pupils (grade 8) are part of the state examination, for certification purposes.	norm scores based on a national sample. If students do not match the level expected in 1F before the end of elementary school (at the age of 12), this is an indicator for remedial education being required.	adapted teaching. Low achievers are identified as the lowest 20% of performers in the Mapping tests.	measure progress in learner achievement annually. At least 50% is required in order to be deemed to be performing at the "adequate achievement" level.
Role of the teachers in the assessment processes	Teachers should formulate judgements on the level descriptions in the National Curriculum on the basis of their knowledge of a child's work over time. They should take	Teachers validate common-base skills in the personal skills record book and are responsible for completing it.	Teachers carry out assessment and are responsible for their educational decisions.	Teachers are responsible for the ongoing assessment of their own pupils' progress and achievement. They are advised to use a variety of assessment methods to support them in making	Teachers have the responsibility of assessing students, documenting this assessment through periodical tests and choosing the appropriate assessment tools, consistent	Schools and classroom teachers are responsible for students' assessment.	Teachers hold the key responsibility for student assessment at all levels of the school system. Results from national tests shall give the teacher a better starting point for adapting the teaching to	Teachers are also supplied with "pace setters" which specify which topics need to be taught on a week by week basis. They are responsible for marking the national assessments.

	into account written, practical and oral work as well as classroom work, homework and the results of informally administered tests taken in class.			decisions about students' future learning.	with the national curricula.		individual pupils and planning tempo, methods and contents.	
Institutional indications to carry out students' assessment	Schools' development of their own approaches to assessment are encouraged by the National curriculum.	Teachers have to certify students' mastery of the items connected to each competence of the Socle commun in the "Livret Personnel de Compétences" (LPC). The Department for National Education provides teachers with reference grids for students' evaluation.	The national educational standards, published as regulations of the Ministry of Education and Cultural Affairs and are binding on teachers. Curricula are only binding state-wide (different curricula from state to state). All the teachers of a specific subject at one school hold conferences to reach a degree of	The National Council for Curriculum and Assessment guidelines present nine assessment methods as a continuum of approaches ranging from those where the child takes the lead to those where the teacher has a greater role in leading the assessment activity.	The recurrent and annual evaluation of pupils should be consistent with the learning objectives established in the Plan for the Formative Offer of each school, where the Teachers' Assembly defines the methods and criteria for assuring that pupils' assessment is homogeneous, transparent and equal.	Documents which describe operationalisation of reference levels are provided to teachers to enable them to decide if a student needs a trajectory at the fundamental levels.	The National Quality assessment system provides access to a range of data intended to help schools, school owners and education authorities evaluate their performance and inform strategies for improvement.	This is very varied in South African schools. In some institutions there is support for students' assessment but in many others the assessment is somewhat haphazard.

			consensus on methods and assessment criteria.					

Table 2: Comparative analysis of the possible pathways for low achievers in the FaSMEd countries

	England	France	Germany	Ireland	Italy	Netherlands	Norway	South Africa
Differentiated teaching	Sufficient opportunities for differentiated work for pupils of all abilities should be given. Differentiation is defined as providing learning experiences which are matched to the needs, capabilities and previous learning of individual pupils. At primary school, many teachers use within-class ability grouping, which involves dividing a class	At primary level two hours of personalised work per week have been prescribed for remedial work with the students identified through the two National assessment tests in classes CE1 and CM2. At any time of compulsory education, a "Personalized program of educational success" is offered to all students who risk to not achieving the objectives of the Socle Commun. "Personalized program of educational success" is offered to all students who	Reinforcement of individual support through diagnostic procedures as a basis for assistance and differentiated support beyond normal lessons, through the use of new teaching materials and alternative forms of learning that strengthen the links with the world of work.	The first stage of support for underachievers in the Response to Intervention involves within-classroom support through team-teaching initiatives, according to a learning plan, which is drawn up and implemented for at least one term. A growing emphasis is given on the provision of support to individual students within classroom.	Remedial activities during the ordinary lessons are part of each school's "Plan of formative offer".		Work plans to differentiate learning according to students' abilities: variations in the use of work tasks, curriculum content, working methods, teaching aids and in the organisation of and intensity of the teaching.	The curriculum document states that 'inclusivity should become a central part of the organisation, planning and teaching at each school', going on to state that 'teachers should use various differentiation strategies'. South African schools vary enormously.

	into small groups for part of the school day, instructing each group separately and providing differentiated work.	risk to not achieving the objectives of the Socle Commun. It usually comprises support measures such as differentiated learning.						
Follow-up teaching		The first year of low secondary school as well as in high school, special courses (accompagnement personnalisé) could be organised for low attainers.			At lower secondary school, increasing tuition time in specific knowledge domains in favour of underachievers and remedial courses must be planned according to the results of the periodical students' assessment. Specific recovery interventions, in Italian and in Mathematics, starting from the first year of lower secondary school. The organisation of group activities for the students, subdivided according to	At primary school, if a teacher registers a delay in mathematics, a first step is taken by providing additional instruction to the student, in groups or individually.	Municipalities may reassign 25% of the classes for a given subject to help pupils attain the goals for their subjects as a whole. The subject syllabus goals cannot be deviated from, even if classes are reassigned. Any reassignment must take place in cooperation with the home and requires the consent of each pupil or apprentice, as well as their parents or guardians.	Once low performing schools have been identified, extra tuition for learners in the form of after school or Saturday tutorial sessions and holiday classes are sometimes provided on a school-by-school basis.

					their level, is privileged.			
Setting	Primary schools may group pupils by ability in a particular subject. Most lower secondary schools group pupils according to ability in a particular subject for some subjects only, such as mathematics and languages.		Among the new forms of learning advocated by the Resolution of the Standing Conference, there is teaching small groups of pupils with similar achievement levels.				Pupils in need of special education are assisted by a specialist teacher, either in the regular classroom or in differentiated groups.	There are the privileged "5th quintile' schools where students are often placed in sets according to their previous achievement. However, in the other schools (1st to 4th quintile), the classes are big, the classrooms are crowded and the dominant pedagogic approach is 'lecture' style (no opportunity for differentiation).
Small-groups tuition outside the classroom		The "Personalized program of educational success" sometimes comprises small group instruction and ability grouping.	Low Achievers can attend additional small group "support lessons" organized by the school.	The second stage of support for underachievers in the Response to Intervention is denominated *school support stage*. It involves that students are withdrawn from their normal classes and taught within small groups.		Pupils can also attend special courses to help them overcome fear of failure or to make them more resilient. These are not government-funded.		Individual teachers may decide to offer small-groups tuition outside the classroom.

Individual tuition			It is based on the materials given to students by teachers. Private tuition is increasing, either from higher achieving/older students or from professional private tuition companies.	The second stage of support for underachievers in the Response to Intervention could also involve extra literacy/numeracy support in form of individual-level tutoring in addition to further in-class support through team-teaching initiatives.	Afternoon assistance to students who need aid are part of the remedial activities.		Some students with special education needs may be assisted by specialist tutors	Individual teachers may decide to offer individual tuition outside the classroom.
Support given to teachers by the schools		In primary schools, some teachers and psychologists are organised in specialized networks to assist pupils to provide specialized assistance to students having local or permanent learning difficulties.	It depends on the schools. Activities are not coordinated.	When pupils may be underachieving in certain areas of academic attainment, the class teacher/principal refers to the Learning Support Team in the school.		Many schools have remedial teachers to assist in extended instruction, or internal counsellors to assist the teacher in decision-making about how to give support to their low attainers.	All schools are expected to have special educational needs expert teachers	

Table 3: National or regional projects/studies/initiatives concerning low achievement in Mathematics and Science in the FaSMEd countries

	England	France	Germany	Ireland	Italy	Netherlands	Norway	South Africa
To develop different kinds of materials for low-achieving students	*THINKING THROUGH MATHEMATICS*. EVERY CHILD COUNTS (ECC). NATIONAL NUMERACY.		MATHE SICHER KÖNNEN.	JCSP NUMERACY	PON SOS-STUDENTI.	PASSENDE PERSPECTIEVEN. SPECIAAL REKENEN.	The Virtual Mathematics School	The NATIONAL WORKBOOK INITIATIVE.
To share innovative materials with teachers / To foster teachers' reflections on the teaching and learning processes	The projects developed by the STEM centre. The projects developed by the National Centre for Excellence for the Teaching of Mathematics (NCETM)		SINUS.		EMMA EMERMAT		The projects developed by the Norwegian centres for Mathematics and Science Education Matematikk	The "Mindset" Network's educational resources.
To improve the teaching of science	STEM PROGRAMME. CASE (Cognitive Acceleration in Science).	ACCOMPAGNEMENT EN SCIENCES ET TECHNOLOGIES À L'ÉCOILE PRIMAIRE (ASTEP).	SINUS. BIOLOGIE IM KONTEXT. CHEMIE IM KONTEXT. PHYSIK IM KONTEXT.				The BUDDING SCIENCE and LITERACY project.	
To improve the teaching of Mathematics	MAKING MATHEMATICS COUNT.	DÉVELOPPEMENT DE LA CULTURE SCIENTIFIQUE ET	SINUS. DZLM.	PROJECT MATHS.	MAT@BEL.	REKEN VERBETER PROJECTEN MATHCHILD.	The projects developed by the Norwegian centre	The NATIONAL WORKBOOK INITIATIVE.

	The MILLENNIUM MATHEMATICS PROJECT	NUMÉRIQUE, ÉGALITÉ DES CHANCES.	T^3 KOSIMA.			LANGUAGE-BASED SUPPORT IN MATHEMATICS EDUCATION. TAL PROJECT	for Mathematics Education	
To raise students' achievement improving school standards or teachers' implementation of the curriculum	NUMERACY AND LITERACY STRATEGY. LAMP (Low attainers in mathematics); RAMP (Raising attainment in mathematics); IAMP (Improving attainment in mathematics); ILM (Improving Learning in Mathematics).		MATHE SICHER KÖNNEN. BIOLOGIE IM KONTEXT.	LITERACY AND NUMERACY FOR LEARNING AND LIFE.	The NATIONAL PLAN FOR QUALITY AND MERIT (PQM-PON).		The national initiative Kunnskap gir muligheter for alle	The CURRICULUM AND ASSESSMENT POLICY STATEMENTS. The NATIONAL WORKBOOK INITIATIVE.
To foster new assessment strategies to support learning	The Assessment for Learning (AfL) Strategy			JUNIOR CYCLE ASSESSMENT.	AVIMES	IMPULSE (Inquiring Mathematical Power and Unexploited Learning of Special Education students).	The initiative Vurdering for læring (Assessment for Learning)	The numeracy component of the ANNUAL NATIONAL ASSESSMENTS.
To analyse affective factors							ROSE (Relevance of Science Education).	
To enable specific categories of people to see STEM as an educational choice for them	Women in Science Education (WISE)						IRIS (Interests and recruitment in science). The VILJE-CON-VALG project.	
To raise the relevance of	SET FOR SUCCESS.		MintEC.		PLS (Progetto	TALENTENKRACHT	LEKTOR 2.	

Mathematics and Science	STEMNET project.				Lauree Scientifiche).		ROLE MODEL project. The initiatives developed by the Nasjonalt senter for realfagsrekruttering (National center for science recruitment)	
To decrease high dropout rate							FYR (Yrkesretting og relevans).	