IRELAND [5] - 2013
PROJECT MATHS

A. BASIC INFORMATION

Country:	Ireland
Title of initiative:	Project Maths
Coordinator/ Organization:	National Council for Curriculum and Assessment (NCCA)
Key competences addressed:	Mathematical proficiency and the five key skills of the NCCA Framework of Key Skills (senior cycle) are also embedded in the curriculum. These are: information processing, communicating, being personally effective, working with others, and critical and creative thinking.
Type of initiative and channels used for implementation (e.g. curriculum reform introduced through legislation etc.)	Curriculum reform at lower and upper secondary level, introduced through legislation.
Partners:	Department of Education and Skills (DES) State Examinations Commission (SEC)
Scope: (student/teacher/school level; local/regional/national)	National
Learning context: (formal or non-formal)	Formal
School education level/s: (primary, lower secondary, upper secondary)	Lower and upper secondary
Target groups:	All students of mathematics
Time frame: (start and end date)	· September 2008 in an initial group of 24 schools · September 2010 in all other schools
Relevant links:	www.ncca.ie/projectmaths www.projectmaths.ie

B. SUMMARY

Following a review of post-primary mathematics education in 2007, the National Council for Curriculum and Assessment (NCCA) prepared a strategy, Project Maths, for the phased 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.

The focus has been on the development of mathematical competence, while the five key skills (communicating, working with others, critical and creative thinking and information processing and being personally effective) have also been embedded in the curriculum.

Beginning with an initial 24 schools, the Project Maths initiative was unique in Ireland in that it placed teachers at the centre of the curriculum development process. Teachers' experiences and feedback informed refinements and subsequent revisions as the new curriculum was being rolled out. This initiative has now been mainstreamed in all Irish schools.

Project Maths can be summarised as the desire to allow students to learn mathematics by thinking mathematically, particularly in concrete, real-life situations. The biggest change was the contextualisation of content, the change in teachers' beliefs about mathematics, teaching and learning and the evaluation of student comprehension.

C. IN DEPTH INFORMATION

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

The project arose from a series of observations of dissatisfaction regarding both students' lack of interest in mathematics and their insufficient level of the basic mathematical reasoning needed to successfully pursue studies in higher education or to ensure that they are not disadvantaged in 21st century society. The results of Irish students in PISA studies (2000 and 2003) and in subject examinations also added to these concerns.

Studies examining the mathematics curriculum in secondary education found that the didactic approach was highly traditional, with a limited emphasis on problem-solving. Teaching strategies were based on rote learning and an insistence on routines and procedures, with a lack of context, application and in-depth knowledge of basic concepts. The last forty years in mathematics education have also been characterised by a culture of elevated abstraction.

There was also a period of reform of the curriculum at upper secondary level; part of this reform was the embedding of key skills in the curriculum: http://www.ncca.ie/en/Curriculum_and_Assessment/Post-Primary_Education/Senior_Cycle/Key_Skills/.

Objectives:

By changing the learning experience of students in Irish secondary schools Project Maths aims to empower students to develop mathematical proficiency (see below, Detailed explanation of the key competence/s concerned, for a full definition of this competence).

In addition, the initiative promotes the development of five key skills identified as central to teaching and learning across the curriculum: information processing, being personally effective, communicating, critical and creative thinking and working with others.

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

Second-level curriculum and assessment and teacher professional development.

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

Beginning in September 2008 with an initial 24 schools, the Project Maths initiative was unique in Ireland in that it placed teachers at the centre of the curriculum development process. Draft syllabuses were agreed in the usual way at committee level within the National Council for Curriculum and Assessment (committees are comprised of representatives from organisations that represent stake holders in Irish education) and implemented by teachers in their classrooms in these 24 schools. Teachers' experiences and feedback then informed refinements and subsequent revisions of the project. The 24 schools in this initial phase were selected from over 220 schools that volunteered to take part. Schools were chosen through a stratified process to reflect the broad spectrum of schools in the Irish educational system at secondary level.

There were five revised syllabus strands:

- Strand 1 Statistics and Probability
- Strand 2 Geometry and Trigonometry
- Strand 3 Number
- Strand 4 Algebra
- Strand 5 Functions

The implementation was phased over a three-year period with strands 1 and 2 introduced in the 1st and 5th years of post-primary schools in September 2008, strands 1, 2, 3 and 4 (also for 1st and 5th years in the 24 schools) in September 2009 and all 5 strands (for 1st and 5th years) in September 2010. National rollout followed after a gap of two years.

The basis for continuing professional development (CPD) was provided by the exchange of experiences within professional networks that were developed to support teachers in the adaptation to the changes. The professional development programme provided for ten full-day workshops over five years; these workshops were designed to help teachers with pedagogical questions rather than to discuss the programme content. Establishing dialogue, discussion and debates on the teaching model were important elements of these workshops. Teacher training sessions for Project Maths had a strong focus on pedagogical aspects and teaching methods

In response to requests from teachers for additional support in content knowledge, these workshops were complemented by a range of optional evening courses, run in local Education Centres, which dealt mainly with mathematics topics (content) and/or with using ICT in the teaching and learning of mathematics. These supplementary courses, which were attended by a significant number of mathematics teachers, were facilitated by trained teachers who were supported in their role, by the team leading the professional development, and who were drawn mainly from the membership of the Irish Mathematics Teachers' Association.

In addition, elective summer maths courses have been organised at the National Centre for Excellence in Mathematics and Science Teaching and Learning (NCE-MSTL), based in the University of Limerick, in order to meet the growing professional development needs of teachers. Feedback from teachers in the initial schools of the project indicated that collaborating formally and informally with colleagues was the most valuable support in helping them change their practice. As a result, the development of communities of practice is the priority for providing support to these schools in the coming year and this development will inform the national programme of support in subsequent years. The project originally gave a commitment to supporting the professional development of teachers for a minimum of five years; the response of teachers to date shows an enthusiasm for continued engagement in the process of change and for making use of the opportunities that are available to support them in doing so.

Detailed explanation of the key competence/s concerned:

Mathematical competency is characterised as:

- conceptual understanding: comprehension of mathematical concepts, operations, and relations
- procedural fluency: skill in carrying out procedures flexibly, accurately, efficiently, and appropriately
- strategic competence: ability to formulate, represent, and solve mathematical problems in both familiar and unfamiliar contexts
- adaptive reasoning: capacity for logical thought, reflection, explanation, justification and communication
- productive disposition: habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence, perseverance and one's own efficacy.

These five competences are interwoven and interdependent in terms of learning. Informed by international trends, Project Maths also develops key skills by promoting a 'collaborative' culture where mathematics is seen as a network of ideas that teacher and students construct together. Learning is seen as a social activity in which students are challenged and arrive at understanding through discussion. Teaching is seen as a non-linear dialogue in which meanings and connections are explored and misunderstandings are recognised and made explicit in order for students to be able to learn from them.

The five key skills are also embedded in the curriculum. These key skills are embedded in all new senior cycle subjects as they are being reviewed. More details on the skills can be found here:

http://www.ncca.ie/en/Curriculum_and_Assessment/Post-Primary_Education/Senior_Cycle/Key_Skills/

Specific subjects concerned or cross-curricular approach:

Mathematics

A main message of Project Maths is that mathematics should be taught in contexts that allow students to make connections within mathematics, between mathematics and other subjects and between mathematics and its applications to real life.

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

Commissioning of research:

The process of curriculum development in Ireland is evidence based. The initiative that was to become Project Maths began with the commissioning of research that examined how maths was taught, learnt and assessed in Irish post-primary schools. Alongside this, a review of international trends in mathematics education was also commissioned. Both reports included recommendations for a change in the syllabus, assessment and teaching of mathematics.

Consultation and Discussion:

A consultation on the identified issues was held with an open invitation to respond to the range of issues presented in a discussion paper. This paper identified particular areas of concern that needed to be addressed as part of the review, including the uptake of mathematics at the different syllabus levels and the performance of candidates in the state examinations and international assessments.

Appointment of Committees:

Informed by the consultation and the commissioned research, and following consideration of a number of possible approaches, the NCCA proposed the Project Maths initiative in 2007. The NCCA maths committees were convened to develop syllabus and assessment revision under the Project Maths initiative. These committees comprised representatives of secondary teachers, school management bodies and further education institutions, as well as the State Examinations Commission and the Department of Education and Skills.

Phased implementation:

As mentioned above, an initial group of 24 schools was involved in the phased implementation of the new syllabus and assessment. The experiences of the teachers and students in these schools informed the syllabus development, and the teacher CPD. Two years later, all post-primary schools began the process that mirrored the phased implementation of the initial schools.

Teaching resources were made available for teachers on the websites www.projectmaths.ie and www.ncca.ie/projectmaths, and students and teachers were supported to change their methodologies through the provision of ten workshops (see section on Overall approach for details).

Evaluation:

There is a strong political commitment for the initiative as it is seen as an essential component in the promotion of STEM subjects and the need for students to develop skills for the 21st century. Likewise, industry has backed the initiative, and groups such as Engineers Ireland and IBEC (employers' group) have supported and promoted the aims of Project Maths.

Independent research has been commissioned to evaluate the initiative. To date, a report has been published on the impact of Project Maths on student achievement and attitudes: Research into the impact of student achievement and motivation (http://www.ncca.ie/en/Conference/Impact%20of%20Project%20Maths%20Final.pdf)

This report highlighted that while some of the teaching approaches advocated by the syllabus are evident in classrooms, students still rate poorly on problem-solving and reasoning and a high number of teaching practices consistent with traditional teaching methodologies prevail. However, improvements have been seen in students' understanding of statistics and probability.

A second report involving case studies and the assessment of samples of students' work will be available in the autumn.

There has been a significant increase in the numbers of students who are following the Higher Level syllabus, but this could be partly to do with the allocation of bonus points for Higher Level maths for entry to further education.

Present stage/phase of implementation:

In September 2013 all schools will be implementing the five revised strands. The implementation will continue to be monitored as teachers are expressing concerns about issues such as the length of the syllabus and the increased time required to teach in a student-centred way. It is hoped that changes to the CPD will alleviate some of these concerns.

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

The problem-solving approach is not completely understood by teachers and there is evidence that the classroom tasks in which students are engaged provide them with only with opportunities to develop procedural fluency and do not support the development of the other competencies necessary for mathematical proficiency.

Teachers tend to view problem-solving as something that they have to do in addition to teaching content rather than as an approach to teaching or a key competency and skill that students should be constantly developing. Other challenges for teachers include using open-ended activities, creating mathematical discussions, designing and selecting quality tasks and making connections between different areas of mathematics. The workshops have aimed to support the development of these skills and methodologies, but it is questionable whether teacher support in the form of workshops is the most effective method and whether it meaningfully impacts on teachers' classroom practices when they return to their schools.

For teachers' views on the experience of being involved in the initiative, see the report Project Maths: Reviewing the project in the initial group of 24 schools –report on school visits (http://www.ncca.ie/en/Curriculum_and_Assessment/Post-Primary_Education/Project_Maths/Resources/Experiences_of_teachers.pdf)

What works well (to identify enablers):

- Teachers have started to make connections within mathematics, between mathematics and other subjects, and between mathematics and its application to real life; furthermore, students report that they are enjoying mathematics lessons. More active methodologies are being used in the classrooms and there is evidence of key skills being implemented (working with others, communication, critical and creative thinking).
- Teachers reported that working more closely with colleagues helped them adapt to the changes, and that sharing practices both within schools and between schools was highly beneficial. A supportive school administration that allows time for department planning was also reported to be advantageous.
- Some teachers report that the use of ICT has worked well; using mathematical software for student investigations and the setting up of virtual learning environments has engaged and motivated students in some settings.
- Summer schools, in particular where teachers received the 'big picture approach' to teaching statistics and probability, were reported to have been valuable and may account for students' improvement in their understanding of these strands.

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

The Project Maths initiative, which is more than just a syllabus revision, requires a different set of beliefs, a connected and challenging view where mathematics is seen as an interconnected body of ideas and reasoning processes. Learning is seen as a collaborative activity in which learners are challenged and arrive at understanding through discussion. Teaching is seen as exploring meaning and connections through non-linear dialogue between teacher and learners, presenting problems before offering explanations, and making misunderstandings explicit and learning from them.

The simultaneous phasing-in and piloting was complex and made it difficult for teachers to readjust their beliefs. The negative effect of the high stakes Leaving Certificate examination on teaching and learning was also a major contributor to the difficulties teachers experienced in readjusting their views. Both teachers and students are comfortable 'teaching to the test' and there is evidence that Irish mathematics teachers view their role as examination coach rather that facilitator of learning. So far evidence is pointing towards the fact that the syllabus strands are being implemented in a traditional way. Now that the fully-revised syllabus is being implemented in all schools, the CPD is concentrating on the connectedness of the strands and a more reflective approach is being encouraged in order to help teachers choose tasks and manage them in the classroom in a way that will encourage the development of skills associated with all aspects of mathematical proficiency.

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

- Teachers involved in the initial 24 schools were asked about their experiences (see the report Project Maths: Reviewing the project in the initial group of 24 schools –report on school visits (http://www.ncca.ie/en/Curriculum_and_Assessment/Post-Primary_Education/Project_Maths/Resources/Experiences_of_teachers.pdf)
- The Department of Education and Skills (DES) inspectorate visit schools to talk with teachers and observe lessons. They provide feedback and advice to teachers. The State Examination Commission (SEC) is responsible for preparing the examination papers. In 2008 they trialled the draft sample paper in the 24 initial schools. The purpose of the trialling process was to measure the effectiveness of the papers and the marking schemes they produced a comprehensive report providing information on what the questions were designed to assess and how learning was evaluated available at (available at http://www.examinations.ie/schools/Report_on_Trial_final.pdf) and provides information on what the questions were designed to assess and how learning was evaluated. A feedback report on the phase 2 examinations in the initial schools is available at http://www.examinations.ie/schools/Feedback_on_2011_LC_Phase_2_exams.pdf.
- Progress in the state examinations is also monitored by the SEC as is the proportions of students opting to take the examination at Higher Level.
- Feedback from the DES and the SEC informs the syllabus development and the CPD provision.
- A curriculum comparison of the Project Maths syllabus with mathematics syllabuses in 5 other countries is available here http://www.ncca.ie/en/Curriculum_and_Assessment/Post-Primary_Education/Project_Maths/Information_on_Project_Maths/Curriculum-comparison.pdf

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

The report of an external evaluation of the impact of Project Maths on student achievement, motivation and learning will be published in autumn 2013. An interim report, published in November 2012 is available at:

http://www.ncca.ie/en/Conference/Impact%20of%20Project%20Maths%20Final.pdf

Communication of the initiative/dissemination of outputs and activities:

- A Teacher Zone at www.ncca.ie/projectmaths provides personal teacher reflections on their experiences of implementing and managing tasks that support the development of skills associated with mathematical proficiency. It also shows examples of student work with discussions about the learning achievements of the students.
- A dedicated PD website exists at www.projectmaths.ie where teachers can access lesson ideas and resources.

Next steps/follow-up:

The implementation will continue to be monitored. Teacher support will be re-evaluated in light of the findings from the evaluation of the impact of Project Maths on student achievement, motivation and learning. The Mathematics Development Group (NCCA committee of stakeholder representatives) will consider the issue of assessment in light of the significant effect the high stakes Leaving Certificate examination is having on teaching and learning.

Additional information:

The work on Project Maths was the subject of a KeyCoNet Peer Learning Visit to Dublin in March 2013.

- The report can be found here: http://keyconet.eun.org/c/document_library/get_file?uuid=40852b44-4b67-41ae-bc05-9f7719de1b6f&groupId=11028
- Videos from the schools can be viewed here: http://keyconet.eun.org/videos_dublin