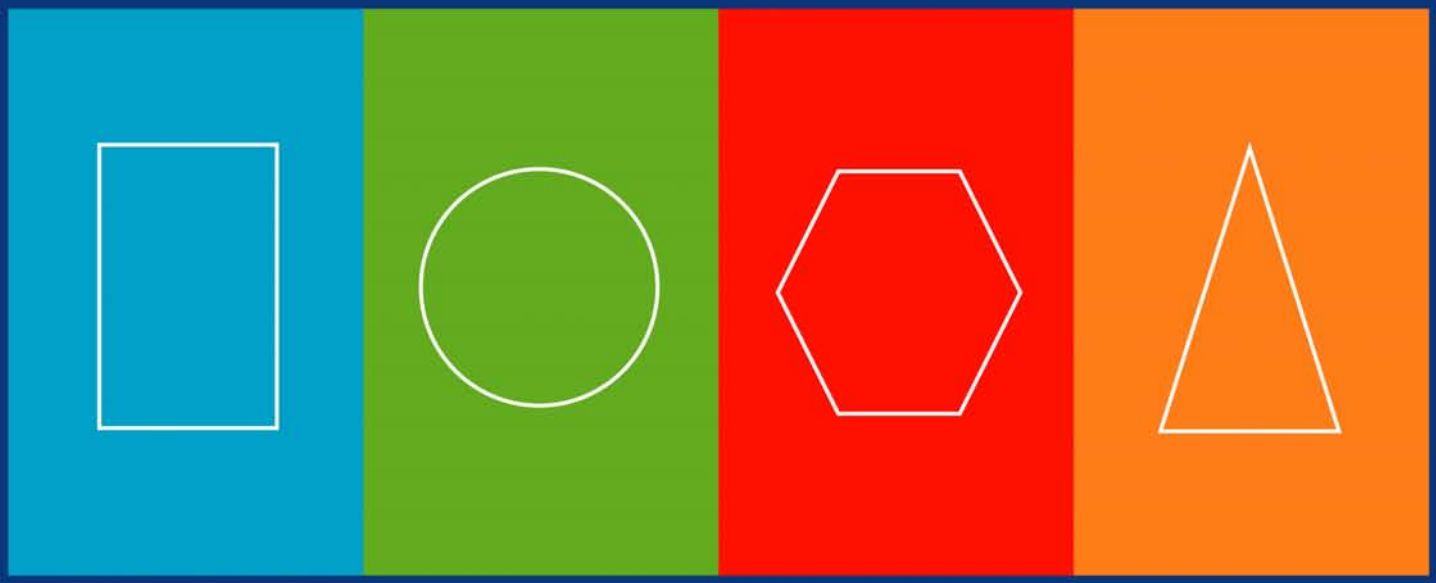


Statement on Raising National Mathematical Achievement

To the Tánaiste & Minister for Enterprise, Trade and Employment and the Minister for Education and Science

November 2008

Expert Group on
Future Skills Needs

Aim of Statement

Ireland must raise its level of mathematical achievement to ensure it will continue to successfully compete with other economies. An adequate supply of people with mathematical, science and ICT skills is crucial to Ireland's future social and economic development. Mathematics is important because it underpins many other disciplines such as science, technology, business and finance. It is a fundamental requirement for the growth of the knowledge economy and the development of a world-class research and innovation system in Ireland[1]. Countries such as Finland, with a high mathematics and science proficiency score, use such performance results to attract inward investment[2]. Mathematical skills are essential for enabling people to fully participate and work in a modern society. Improving national mathematical achievement is therefore vital for all of us.

The importance of mathematics however, can be set against the fact that a relatively low number of students here take Higher-Level Leaving Cert Mathematics. This proportion has remained fairly constant – comprising 18 percent of the Leaving Cert Maths cohort in 2001 compared to 17 percent in 2008 (Annex 1). This outcome does not match the expected pattern of uptake of 20 percent to 25 percent at the time the current syllabus at Higher- Level was introduced in 1992[3].

Another major concern is that some 5,000 students did not achieve a level D grade or higher in Leaving Cert Maths in 2008. For Ordinary Level the failure rate comprised 12 percent of the cohort. Failure rates over recent years have remained stubbornly high, limiting the educational and employment prospects of a significant number of young people.

Towards 2016 – Social Partnership Agreement 2006-2015, states that "*the falling quality in mathematics needs to be addressed for a knowledge economy*". There is an urgent need to build positive attitudes towards mathematics as a discipline and to boost the numbers of students with a high level of mathematical proficiency.

The above challenges highlight the need for a national strategic approach towards raising national mathematical achievement. The need for such a strategic national approach towards mathematics education can be demonstrated through examples elsewhere, such as the US National Mathematics Advisory Panel established to foster improved performance in mathematics among American students[4].

[1] The importance of mathematical proficiency in high-skilled occupations has been identified in recent reports by the Expert Group on Future Skills Needs on the International Financial Services Industry; Irish Medical Devices Sector; and the ICT Sector in Ireland.
[2] Invest in Finland : Finland Tops PISA 2006 news release, 2007 (www.investinfinland.fi/news/2007)
[3] NCCA (2005), *Review of Mathematics in Post-Primary Education - a discussion paper (page 4).*
[4] U.S National Mathematics Advisory Panel (2008), *the Final Report of the National Mathematics Advisory Panel*, U.S. Department of Education: Washington, DC.

This Statement by the Expert Group on Future Skills Needs aims to:

- Give profile to valuable work underway;
- Highlight key issues which remain to be addressed and ;
- Provide policy proposals for future action to address these key issues.

The EGFSN seeks to stimulate fresh thinking by setting out a challenging vision of what it would mean for Ireland to become one of the top OECD countries in terms of mathematics proficiency. This would mean moving upwards from our current position of 16th out of 30 OECD countries for mathematics proficiency among 15-year-old students in PISA tests[5].

The Statement recognises the benefits to children and adults engaging in a positive mathematics environment at all level of the education system from early childhood settings and upwards.

Background Context

The Chief Examiner's Report on the 2005 Leaving Certificate Higher-Level Mathematics paper expressed concerns about a noticeable slippage, over a short period of time, in both the quality of work and the capacity of candidates to engage with problems that were not of a routine nature. Data quoted in the Report of the Task Force on the Physical Sciences (2002) suggests that students who take Higher-Level Leaving Certificate mathematics, physics and chemistry face an effective grading penalty for choosing these three subjects over other subjects. With most Leaving Certificate students studying seven or more subjects, only six of which will count towards points for college entry, an able student can respond to these incentives by treating mathematics as a 'spare' subject, to be taken at Ordinary Level or barely passed at Higher-Level. There is considerable anecdotal evidence that students are doing this in significant numbers.

Mathematical competence is important for many Leaving Certificate subjects particularly in science, engineering, technology, business and finance. The perceived difficulty among students on learning mathematics is seen as influencing their choices of subjects with a high mathematical content- such as physics. This issue was identified in earlier research prepared for Forfás and the Office for Science and Technology[6].

[5] OECD (2007), PISA 2006 Science Competencies For Tomorrow's World, OECD, Paris.
[6] Drury Research (2004), Attitudes and Awareness of Primary and Secondary Students to Science, Technology and Innovation - prepared for Forfás and the Office for Science and Technology: Dublin.

Improving performance in mathematics at upper secondary level will boost the potential supply of graduate recruits for third-level science, engineering, technology and business courses. Many science, engineering and technology (SET) Level 8 degree courses have minimum requirements for attainment in Higher-Level Leaving Certificate mathematics, most commonly a C3. Students with strong mathematical skills also tend to perform better than others and are the most likely to develop strong technical skills.

At Junior Certificate level, maths is one of two main subjects – Irish being the other – for which a minority of candidates opt for the higher-level syllabus. In 2008, some 23,600 students (43% of the number who took maths) sat higher-level maths in the Junior Cert (compared to 37% in 2001). Encouragingly, around 80 percent of these candidates gained an honour in the subject. However, nearly two-thirds of Junior Cert Higher-Level Maths students drop down to Ordinary Level at Leaving Cert. In 2008 some 8,500 students opted for Leaving Cert Higher-Level Maths – comprising 17 percent of those who took Leaving Cert Maths. Seventy-eight percent of candidates who sat Leaving Cert Higher-Level Maths gained an honour in the subject- again a positive achievement.

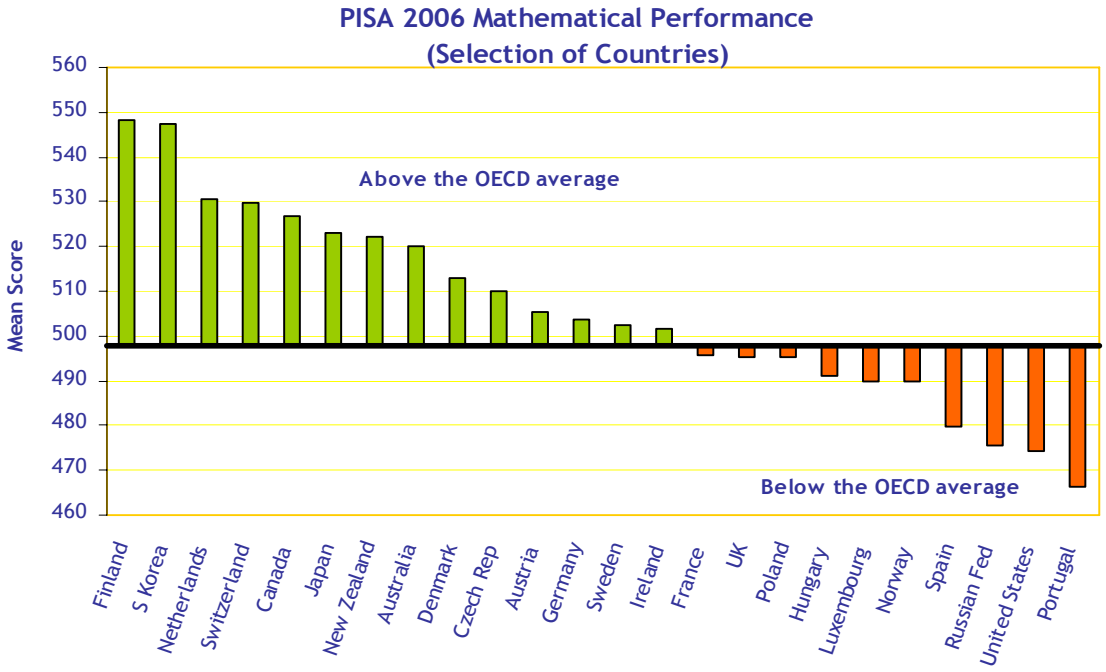
The initial building block for developing mathematics proficiency is at primary school level. However, an Educational Research Centre (ERC) report on primary school mathematics - *Counting on Success* (2006) - reports that over the period 1999 to 2004 there was actually a significant reduction in the amount of time allocated each week to teaching mathematics[7]. Other research indicates that a significant number of weaker students are not getting enough help with their maths in primary school[8]. This research found that such pupils receive three times more assistance with their English as they do with their maths from learning-support teachers.

Irish Mathematical Performance

Ireland's mean performance on PISA mathematics assessment for 15-year-old students has not changed significantly since it was included as a major assessment domain in 2003. In the most recent assessment, Ireland's mean score was around the OECD average, ranking Ireland 16th highest amongst 30 OECD countries. Ireland's score was lower than non-OECD developing competitor countries such as Taipei and Hong-Kong.

[7] In this regard, the NCCA *Review of Mathematics in Post-Primary Education - Report on Consultation (2006)*, noted that many teachers commented on the lack of sufficient time for mathematics, particularly in the Junior Certificate – attributed to an overloaded curriculum as a result of the introduction of additional subjects or modules.

[8] Gerry Shiel, Educational Research Centre, St Patricks College, Drumcondra and Paul Surgenor, Dublin Institute of Technology (2008)



Source : OECD 2008 (Average Mean Score 498)

Findings summarised for Ireland indicate that fewer students (10 percent) achieved the highest mathematics proficiency levels (5 and 6), compared to the OECD average (13 percent)[9]. A gender difference is evident with only 8.3 percent of Irish females classified at the highest proficiency levels compared to 12.3 percent of Irish males. Meanwhile, South Korea, Finland, Switzerland, Belgium and the Netherlands all had more than 20 percent of students achieving at these top levels. On the positive side, fewer students here scored at the lowest proficiency level (at or below level 1) compared to the OECD average (16 percent for Ireland compared to OECD average of 21 percent). However, this outcome may be compared against Finland where only 6 percent of students scored at this low proficiency level. Again, a gender difference was evident, with 17.3 percent of Irish females failing to attain level 2 compared to 15.4 percent of Irish males.

Overall, Ireland had a relatively narrower spread of mathematics proficiency achievement compared to the OECD average – which is a positive result. However, when comparing to top performing countries, there is scope for improving the numbers achieving at the highest proficiency levels and reducing the number of those at the lowest proficiency level. Gender differences are also evident, with males outperforming females – although this mirrors international trends.

[9] Educational Research Centre (2007), *Ready for Tomorrows World?: The competencies of Irish 15-year-olds in PISA 2006*, prepared for the Department of Education and Science by the Educational Research Centre: Dublin.

Issues of Concern from an Enterprise Perspective

The current level of our mathematical achievement is of serious concern to employers. Mathematical concepts, models and techniques are central to working in all sectors of employment and are equally important to service jobs as to manufacturing jobs. The proficiency level of students in mathematics is a key factor influencing the domestic supply of graduates for sectors with growth potential such as ICT, Life Sciences and Business, Financial and Professional Services. Boosting the level of our mathematical capability would help ensure opportunities for employment growth could be fully realised.

However, the number of students entering honours degrees in computing and electronic engineering degree courses has declined significantly in recent years. This has lead to a gap between the domestic supply and demand for high-level ICT skills as highlighted in the EGFSN report – *Future Requirements for High-Level ICT Skills in the ICT Sector*. The EGFSN report on *Future Skills and Research Needs of the International Financial Services Industry* highlighted a lack of graduates with specialist skills in areas such as statistics, economics actuarial studies and international taxation.

Mathematical proficiency is not limited only to high-skilled jobs. Workers in low and medium skilled level jobs also require at least basic mathematical proficiency - for example, the ability of retail workers to function effectively when engaged in tasks involving numbers e.g. sales transactions, stocktaking, product layout, etc. In order to foster a knowledge-based economy, business is calling for radical measures to boost the numbers of students performing well in Higher-Level Leaving Certificate Mathematics and to increase overall national mathematical proficiency

Issues of Concern from an Individual Perspective

Mathematics literacy is defined by the OECD as "an individual's capacity to identify and understand the role that mathematics plays in the world, to make well founded judgements and to engage with mathematics in ways that meet the needs of that individual's life as a constructive, concerned and reflective citizen". Improving the quality of mathematics outcomes is important for individuals as well as enterprise. Mathematical and numeracy skills are essential for people living and working in a knowledge society and for accessing good quality employment opportunities. It imparts analytical and problem-solving skills which along with team-working, communication skills and creative thinking are core skills increasingly required across all jobs. Mathematical competence is an essential life skill required by all school leavers and adults for participating in a modern society.

It is the ability to develop and apply mathematical thinking in order to solve a range of problems in everyday situations[10].

These include household budgeting, payment for goods and services, salary payments, credit terms, saving and loan interest rates, tax payments, pensions options, sizing home improvements, calculating travel distances, recipe instructions etc.

Students who do not take Leaving Cert Higher-Level Mathematics limit their opportunity to pursue rewarding professional career opportunities in science, engineering, ICT and business as well as access to many third-level courses. The high numbers of young people who fail maths at Leaving Cert (some 5,000 in 2008) are at a particular disadvantage. This will limit their participation in further education, access to quality employment opportunities and future career progression.

Developments in Ireland to improve Mathematics Proficiency

Primary school teacher training and in-service professional development comprise key areas for the development of mathematics proficiency. Over recent years, the Department of Education and Science (DES) has invested more in the in-service development of teachers. This is essential given findings in the DES Inspectorate report, *Beginning to Teach* (2005), that 28 percent of new primary teachers felt themselves to be "*poorly prepared*" to teach mathematics. In the ERC/DES report, *Counting on Success – Mathematics Achievement in Irish Primary Schools*, (2006), 70 percent of school inspectors described teacher's knowledge of methods for teaching mathematics as "*somewhat limited*".

Both the mathematics curriculum in primary schools and the Junior Certificate mathematics syllabuses have been revised. The 2006 *Review of Post-Primary Mathematics* by the National Council for Curriculum and Assessment (NCCA)[11] resulted in proposals for *Project Maths*. This is an ambitious strategy for the development of curriculum, teaching, learning and assessment in mathematics for post-primary schools- with an increased emphasis on problem-solving skills, and context and application. The NCCA is leading this project in collaboration with the Department of Education and Science and the State Examination Commission.

[10] As defined in Recommendation of the European Parliament and of the Council Dec 2006 on Key Competences for Life Long Learning

[11] The NCCA is the statutory agency that advises the Minister for Education and Science on matters relating to the curriculum for early childhood education, primary and post-primary schools and the assessment procedures employed in schools and examinations on subjects which are part of the curriculum.

Implementation of syllabus change will be accompanied by teacher professional development, the provision of classroom support materials and incremental reform of mathematics examinations. Twenty-four second-level schools are participating in the developmental stages of the syllabus revision. The initiative will be rolled out to all schools from late 2010 onwards prefaced by a programme of professional training for teachers starting the previous year. The Science Foundation Ireland Mathematics Initiative aims to encourage mathematical research with a potential impact on enterprise, industry, science, engineering and mathematical education.

International Developments to improve Mathematics Proficiency

In European terms, Finland and the Netherlands perform significantly better than Ireland. For OECD countries, Finland is first for science, second for reading and first for mathematics proficiency in OECD PISA tests for 15 year olds. There are lessons that can be learnt from practice in these and other countries to inform and enhance mathematics education development here in Ireland.

In Finland, both mathematics and science have been subject of a nation-wide project aimed at raising the quality of teaching and increasing the numbers of students specialising in these disciplines. The project introduced new approaches to the teaching of mathematics and science for a large number of teachers, many of who had completed their subject teacher education several years previously or had undertaken their training with no specialisation in the teaching of mathematics. The new curricular guidelines emphasised problem-solving proficiency as one of the primary goals of the teaching of mathematics. In 2004, the Finnish National Board of Education published the new *Curriculum Basics*, within which 'mathematics thinking' and 'the structure of maths' are essential items of the new curriculum.

Over the last decade, the Netherlands has been very active in the innovation of science and mathematics education. Realistic Mathematics Education (RME) stems from the Netherlands. It emphasises the solution of problems set in contexts which engage student's interest. This approach has been taken up in many countries and underpins the OECD Programme for International Student Assessment (PISA).

The quality of teaching of mathematics at both primary and secondary level is essential to improving mathematics proficiency[12]. The careful selection and training of the right candidates for teaching is crucial. Best performing countries invest considerable resources and time in constantly improving their teacher's capability.

[12] McKinsey and Company, (2007), *How the world's best school systems come out on top.*

Research demonstrates the positive relationship between the mathematical knowledge of teachers and student's achievements[13]. Targeted supports are also required to ensure that pupils fully benefit from excellent instruction.

Key Issues which need to be addressed

The main challenges facing Ireland becoming one of the top OECD countries in terms of mathematical performance are the need to: (i) improve the quality and level of mathematical knowledge outcomes for all; (ii) increase the number of students achieving at the highest proficiency level; and (iii) reduce the numbers of students achieving at the lowest proficiency level.

These complementary goals can be realised by actions in the following areas:

- Encouraging more Leaving Cert students (particularly females), to take Higher-Level Maths – in line with current NCCA targets of 60 percent at Junior Certificate and 30 percent at Leaving Certificate - thereby boosting the potential pool of students for SET and business subjects at third-level. The focus should be on encouraging those capable of achieving A1 and A2 grades in Ordinary Level Maths to move up to Higher-Level.
- Enhancing the mathematical knowledge and competence of both primary and second-level maths teachers in their initial training and continuing professional development (estimates are that only around 20 percent of teachers of second-level mathematics studied maths as a major subject beyond the first year of their primary degree[14]).
- Improving the teaching of mathematics within Leaving Certificate subjects that have a relatively high mathematical content - particularly science subjects such as physics - with the aim of increasing the numbers taking such courses.
- Providing improved teacher learner-support to weaker students at primary level who have a learning difficulty in maths. This is one contributory factor why so many young people go on to fail maths at Leaving Cert level.
- Engendering an appreciation of the value of a good mathematical education and ensuring that workers have the required mathematical knowledge and skills necessary to fully avail of career opportunities and to meet the future skills needs of business.
- Mainstreaming good practice around the teaching and learning of mathematics for students of different ages and abilities, teachers at primary and second-level and for adults.

[13] U.S National Mathematics Advisory Panel (2008), *The Final Report of the National Mathematics Advisory Panel*, page xxi, U.S. Department of Education: Washington, DC.

[14] Royal Irish Academy Committee of Mathematical Sciences and Chemical & Physical Sciences (2008), *Response to the Proposal to offer bonus points for maths*, RIA : Dublin

Core Message of EGFSN Statement

The core message of this Statement is that a national strategic approach is required to improve the level of our national mathematical achievement- in terms of both quality as well as numbers. The challenging vision is for Ireland to become one of the top OECD countries in terms of mathematical proficiency. Improving our national mathematical performance will support the development of a world-class research and innovation system and the growth of a knowledge-based society in Ireland. It will provide a competitive advantage with which to successfully compete with other countries.

Improved mathematical proficiency is essential from both an enterprise and individual viewpoint. Business requires a supply of entrants with a high level of mathematical proficiency for potential growth areas such as Life Sciences, Information Communication Technology, High-Value Engineering, Business and Professional Services and more generally across all sectors. Mathematics is important because it underpins many other disciplines at both second and third-level such as science, technology, business and finance.

Mathematical and numeracy skills are essential for people living and working in a modern society and for improving their access to good quality employment opportunities. Mathematical skills impart logical thinking, analytical and problem-solving capabilities, which along with team-working, communication skills, and creative thinking are core competences increasingly required across all jobs- whether at low, medium and high-skill levels.

There are major developments underway within *Project Maths* supported by the NCCA in collaboration with the Department of Education and Science and the State Examination Commission. This ambitious strategy is informed by comprehensive international best practice research on how to improve mathematics teaching and achieve measurable improvements in outcomes. The EGFSN fully support this positive development which will take time to take full effect.

Within this policy context, several complementary policy proposals are made by the EGFSN with the aim of increasing the level of our national mathematical achievement.

These individual policy proposals are not put forward as an answer on their own as to how to improve national mathematical achievement. Each policy proposal is an integral part of a broad set of measures that need to be implemented in a coordinated way to improve national mathematical achievement outcomes. This will require the support of a broad range of partners.

Policy Proposals to Improve National Mathematical Achievement

Provide Professional Development of Teachers at Primary-level and Second-level in the teaching of Mathematics

The professional development of primary teachers in mathematics should be encouraged and rewarded. Their development would be enhanced through Professional Master Degree Courses and other opportunities to improve their 'academic mathematics'. The quality of second-level mathematics teaching is central to driving up interest and mathematical proficiency levels. The Department of Education and Science should continue initiatives aimed at enhancing and assessing the quality of mathematics teaching in secondary schools.

Professional development opportunities for second-level mathematics teachers should be provided, including a Professional Masters Degree (taking account of professional experience) and a part-time Higher Diploma in Mathematical Education. Consideration should be given to the introduction of a four year Honours Degree in Mathematical Education to provide another source of mathematics teachers. The allocation of time and resources given to the development of mathematics competence in teacher training courses should be examined.

A part-time teaching degree should be considered aimed at those 'math-base' workers in the workforce seeking a career change who may be attracted to mathematics teaching. They could bring the additional benefit of their work experience.

Develop a more interactive, imaginative approach to teaching Mathematics

A more interactive, imaginative approach to teaching mathematics should be developed to enhance student's mathematics learning and competence. This would help students better understand mathematical concepts including arithmetic, algebra and geometry - and see their relevance to themselves and the world around them. The Primary Curriculum Review found that children are enjoying the active engagement with mathematics and the methodologies being employed in class. This approach should be continued and reinforced at second-level. The more interactive approach to teaching mathematics as being developed by the NCCA within *Project Maths*, should be supported. This including students engaging in discussing real-world/ business problems and how the mathematics involved might be applied to solve them. Problem solving, critical thinking and logical reasoning should be encouraged.

There is a need to make connections within mathematics across subjects such as science, engineering & technology; business & finance; and social sciences.

Develop a more Coherent Progression of Mathematics Learning

Greater support should be given to helping weaker pupils with their maths at primary level. Such early intervention could help reduce the significant numbers of those who go on to fail maths in the Leaving Cert.

The transition from primary to second- level maths learning could be significantly improved. A bridging framework should be developed to ensure that learning at primary level is built upon in early second-level. This would include primary school and secondary school maths teachers meeting to discuss how pupil's progress could be supported between 6th Class at primary level to 1st year at second-level. Work in this area currently being developed under Project Maths should be supported.

There should be an improved continuity in mathematical studies in Transition Year programmes. The lack of continuity in mathematical studies and regular homework at this crucial age should be addressed. Sufficient time should be given to the teaching of mathematics at second-level particularly in the Junior Cycle. The NCCA work on the development of a short course in mathematics would be an important 'add-on' to the full subject for those achieving at the top level.

Support for Parents Role in their Children's Mathematics Education

Parents have a key role to play in encouraging their children's engagement in mathematics education from pre-school age through to second-level. This role, however, can be limited by the fact that many parents do not feel proficient in the mathematics curriculum. Indeed some may have negative impressions of the subject based upon their own experiences.

Concise written and web-based material aimed at enhancing the parent's role in encouraging and supporting their child's mathematics learning should be developed[15]. Schools could also provide parents with short instruction sessions on appropriate level mathematical concepts and learning. The Washington State Guide for students and parents "*Got Math? Multiply your options for the Future*" brochure is a good example of such promotional material[16].

[15] See resource material from Washington State Transition Mathematics Project 'Math Lab', project including "*Math Help- for Parents*" web-based support material as an example- http://www.transitionmathproject.org/resources/mathlab.asp. Another useful example is the New Zealand Government Ministry of Education maths site- http: www.nzmaths.co/nz/. The BBC School Parents help with homework is another useful site – www.bbc.co.uk/schools/parents/work

[16] See Washington State Transition Mathematics Project 'Math Lab', project site.

Incentivise Students to take Mathematics at a Higher-Level

There is a need to level the 'playing pitch' in the choice open to students between taking Higher-Level maths and other subjects. The Department of Education and Science could work with Higher Education Institutions to address the disincentives to studying Leaving Certificate Higher-Level mathematics. In doing so, it could:

- Ask the State Examinations Commission to propose and implement a response to the grading penalty that is perceived to be suffered by students taking Higher-Level Mathematics in the Leaving Certificate; and

- Students could be allowed to take Ordinary Level Leaving Cert Maths in their fifth year and then have the choice of taking Higher Level later in their sixth year – this might mean that the ordinary syllabus should be a subset of the Higher Level syllabus. This would potentially help 'middle-ability' students who feel nervous about taking Higher Level Leaving Cert Maths; and

- Promote the development and introduction of a system of bonus college entry points for Higher-Level Leaving Certificate maths to compensate students for the greater effort widely considered to be required for success in this subject[17].

It should be noted that following the EGFSN ICT Skills report[18] the Department of Education and Science had asked the Higher Education Authority to initiate a discussion across higher-education institutions regarding the desirability or otherwise of awarding bonus points. The overall view emerging was that their introduction was unlikely to dramatically increase uptake of Higher-Level Maths. There was also concern expressed that such a measure would mask the underlying significant challenges facing the teaching and learning of mathematics throughout the education system.

[17] There are views for and against such a proposal as expressed within a recent Royal Irish Academy Committee response – including that should such a decision be made then it must be possible for students to use bonus points for all third-level courses. NESC In their recent 2008 report, *The Irish Economy in the Early 21st Century*, referred to the need to consider the introduction of bonus points to encourage more students to take higher-level maths.

[18] EGFSN (2008) ,*Future Requirement for High-Level ICT Skills in the ICT Sector*, EGFSN: Dublin

Address the Mathematics Knowledge Needs of Adults in the Workplace

There is a need to address the mathematics knowledge needs of adult learners in the workplace through their continuing education and training. An opportunity exists to establish initiatives for the learning of mathematics and numeracy in line with programmes already available on literacy. Such learning should be practically based and of relevance to people in their job. A suite of mathematical knowledge skills modules at various National Framework of Qualifications (NFQ) levels could be developed to be drawn upon by individuals, adult education and business. A mapping of mathematical proficiency requirements across different occupations would help identify the level of mathematical learning required and how it could best be delivered. The aim should be to help people progress by at least NFQ level.

Employers should demonstrate the practical way in which maths is important for individual career paths and opportunities in science, engineering, technology and business etc. The need for improved mathematics proficiency should be promoted along with other key generic skills such as knowledge of ICT, communication skills, team working etc. This could be illustrated through an ongoing communication campaign aimed at increasing interest and knowledge of mathematics education among students, teachers and parents.

Benchmark and Evaluate National Mathematical Education Performance

An ongoing research programme is required to benchmark and evaluate Ireland's mathematical performance in an international context. Results could then be compared annually against an agreed range of national targets set for national mathematical achievement. Such a programme could measure progress and report upon best practice experiences – domestic and international - in curricula, instruction, materials, use of technology, assessments, professional development of teachers etc.

Work already undertaken by the NCCA, the State Examination Commission and the Educational Research Centre could usefully be built upon. This research would inform policy and practice.

Findings could be used to frame a promotional campaign aimed at increasing interest and knowledge of mathematics education among students, teachers and parents.

Selection of References

Barber M, Nourshed M (2007), How the world's best school systems come out on top, McKinsey & Co.

Bjorkqvist O, Akademi A (2005), Mathematics Education in Finland –what makes it work? Abo Akademi University, Vasa : Finland.

Conway P, Sloane F (2006), International Trends in Post-Primary Mathematics Education: Perspectives on Learning, Teaching and Assessment, NCCA: Dublin.

Department of Enterprise, Trade and Employment (2006), Strategy for Science, Technology and Innovation 2006-2013: Dublin.

Educational Research Centre (2007), Ready for Tomorrows World? The competencies of Irish 15-year –olds in PISA 2006, ERC: Dublin.

Educational Research Centre (2006), Counting on Success – Mathematics Achievements in Irish Primary Schools, ERC: Dublin.

EGFSN (2007), Future Skills and Research Needs of the International Financial Services Industry, EGFSN: Dublin

EGFSN (2008), Future Requirements for High-Level ICT Skills in the ICT Sector, EGFSN: Dublin.

Eivers E, Shiel G (2007), Ready for Tomorrows World? , The Competencies of Irish 15-year-olds in PISA 2006, Education Research Centre: Dublin.

Forfás / National Competitiveness Council (2007), Annual Competitive Report 2006, Vol 2, Irelands Competitive Challenge: Dublin.

Heuvel –Panhuizen M (2000), Mathematics Education in the Netherlands, Utrecht University.

Malaty, G (2006), PISA Results and School Mathematics in Finland; University of Joensuu: Finland.

Mc Donagh, S (2006) Towards a National Mathematics Strategy: Dublin

NESC (2008), The Irish Economy in the Early 21st Century, NESC: Dublin.

NCCA (2007), Project Maths: Developing Post-Primary Mathematics Education, NCCA: Dublin.

NCCA (2006), Review of Mathematics in Post-Primary Education–Report on Consultation: Dublin.

OECD (2007), PISA 2006 Science Competencies for Tomorrows World, OECD: Paris.

Royal Irish Academy Committee of Mathematical Sciences and Chemical & Physical Sciences (2008), Response to the Proposal to offer bonus points for maths, RIA: Dublin

Surgenor, P Shiel G (2008) Parity of Provision? Learning support for English and Mathematics in Irish Primary Schools, Irish Educational Studies: Dublin.

U.S National Mathematics Advisory Panel (2008), The Final Report of the National Mathematics Advisory Panel, U.S. Department of Education: Washington, DC.

Appendix 1

Leaving Certificate Results in Mathematics 2008

The total number of candidates who took Leaving Certificate Mathematics in 2008 was 50,116. Of these, the number who took Higher-Level was 8,510 – (17% of total); the number who took Ordinary Level was 35,803 (71.4% of total) and the number who took Foundation Level was 5,803 – (11. 6% of the total). A breakdown analysis of the results by the three different levels is presented below (numbers are calculated from the percentage figures released by State Examinations Commission).

Breakdown of Candidates who took Leaving Certificate Higher-Level Maths by Grade Awarded

Grade Awarded	Number of Candidates	Percentage of Candidates	Cumulative % of Higher- Level Candidates	Cumulative % of all Leaving Cert Maths Candidates
A1	630	7.4%	7.4%	1.2%
A2	588	6.9%	14.3%	2.4%
B1	732	8.6 %	22.9%	3.85%
B2	850	10%	32.9%	5.55%
B3	1030	12.1%	45%	7.55%
CI	962	11.3%	56.3%	9.55%
C2	996	11.7%	68%	11.53%
C3	834	9.8%	77.8%	13.2%
D1	596	7%	84.8%	14.38%
D2	460	5.4%	90.2%	15.30%
D3	450	5.3%	95.5%	16.20%
E	306	3.6%	99.1%	16.81%
F	60	0.7%	99.8%	16.92%
NG	16	0.2%	100%	16.95%
Total	8,510	100%		

Breakdown of Candidates who took Leaving Certificate Ordinary Level Maths by Grade Awarded

Grade Awarded	Number of Candidates	Percentage of Candidates	Cumulative % of Ordinary Level Candidates	Cumulative % of all Leaving Cert Maths Candidates Cont.d
A1	1755	4.9%	4.9%	20.5%
A2	2720	7.6 %	12.5%	26%
B1	3290	9.2 %	21.7%	32.5%
B2	3470	9.7 %	31.4%	40%
B3	3365	9.4%	40.8%	46%
CI	3435	9.6%	50.4%	53%
C2	3150	8.8%	59.2%	60%
C3	2935	8.2%	67.4%	65%
D1	2575	7.2%	74.6%	70%
D2	2290	6.4%	81%	75%
D3	2470	6.9%	87.9%	80%
E	2900	8.1%	96%	85%
F	1325	3.7%	99.7%	88%
NG	180	0.5%	100%	88.5%
Total	35,803	100%		

Breakdown of Candidates who took Leaving Certificate Foundation Level Maths by Grade Awarded

Grade Awarded	Number of Candidates	Percentage of Candidates	Cumulative % of Foundation Level Candidates	Cumulative % of all Leaving Cert Maths Candidates Cont.d
A2	342	5.9%	9.8%	89.7%
B1	510	8.8%	18.6%	90.7%
B2	720	12.4%	31%	92 %
B3	780	13.4%	44.4%	94%
CI	725	12.5%	56.9%	95%
C2	605	10.4%	67.3%	96.4%
C3	540	9.3%	76.6%	97.4%
D1	395	6.8%	83.4%	98.2%
D2	335	5.8%	89.2%	98.8%
D3	290	5%	94.2%	99.4%
E	215	3.7%	98%	99.8%
F	105	1.8%	99.8%	99.98%
G	12	0.2%	100%	100%
Total	5,803	100%		

Appendix 2
Membership of the Expert Group on Future Skills Needs

Ms. Anne Heraty	CPL Resources PLC, Chairperson
Ms. Ruth Carmody	Assistant Secretary, Department of Education and Science
Ms. Anne Forde	Principal Officer, Department of Education and Science
Ms. Liz Carroll	Training and Development Manager, ISME
Mr. Fergal Costello	Head of IoT Designation, Higher Education Authority
Mr. Ned Costello	Chief Executive, Irish Universities Association
Mr. Brendan Ellison	Principal Officer, Department of Finance
Mr. Roger Fox	Director of Planning and Research, FÁS
Mr. David Hedigan	Manager, Sectoral Enterprise Development Policy, Enterprise Ireland
Mr. Gary Keegan	Director, Acumen
Mr. John Martin	Director for Employment, Labour & Social Affairs, OECD
Mr. Dermot Mulligan	Assistant Secretary, Department of Enterprise, Trade and Employment
Mr. Pat Hayden	Principal Officer, Department of Enterprise, Trade and Employment
Mr. Frank Mulvihill	President, Institute of Guidance Counsellors
Dr. Brendan Murphy	President, Cork Institute of Technology
Mr. Alan Nuzum	CEO, Skillnets
Mr. Tony Donohoe	Head of Education, Social and Innovation Policy, IBEC
Mr. Peter Rigney	Industrial Officer, ICTU
Ms. Jacinta Stewart	Chief Executive, City of Dublin VEC
Ms. Una Halligan	Director, Government & Public Affairs for Ireland, Hewlett Packard
Mr. George Bennett	Globally Traded Business, IDA Ireland
Mr. Martin Shanahan	Divisional Manager, Science Technology and Human Capital, Forfás
Ms. Marie Bourke	Head of Human Capital and Labour Market Policy, Forfás (also Head of Secretariat)

Appendix 3
Publications by the Expert Group on Future Skills Needs

Report	Date of Publication
All-Island Skills Study	October 2008
Future Requirements for High Level ICT Skills in the ICT Sector	June 2008
Future Skills Needs of the Irish Medical Devices Sector	February 2008
Survey of Selected Multi-National Employers' Perceptions of Certain Graduates from Irish Higher Education	December 2007
The Future Skills and Research Needs of the International Financial Services Industry	December 2007
Monitoring Ireland's Skills Supply: Trends in Educational/Training Outputs	October 2007
Tomorrow's Skills: Towards a National Skills Strategy	March 2007
National Skills Bulletin 2006	December 2006
Future Skills Requirements of the International Digital Media Industry: Implications for Ireland	July 2006
Careers and Labour Market Information in Ireland	July 2006
Skills at Regional Level in Ireland	May 2006
SME Management Development in Ireland	May 2006
Monitoring Ireland's Skills Supply: Trends in Educational/Training Outputs	January 2006
Data Analysis of In-Employment Education and Training in Ireland	January 2006
National Skills Bulletin 2005	October 2005
Skills Needs in the Irish Economy: The Role of Migration	October 2005
Languages and Enterprise	May 2005
Skills Requirements of the Digital Content Industry in Ireland Phase I	February 2005
Innovate Market Sell	November 2004
The Supply and Demand for Researchers and Research Personnel	September 2004
Literature Review on Aspects of Training of those at Work in Ireland	June 2004
Financial Skills Monitoring Report	November 2003
Responding to Ireland's Growing Skills Needs - The Fourth Report of the Expert Group on Future Skills Needs	October 2003

The Demand and Supply of Skills in the Biotechnology Sector	September 2003
Skills Monitoring Report - Construction Industry 2003/10	July 2003
Benchmarking Education and Training for Economic Development in Ireland	July 2003
The Demand and Supply of Engineers and Engineering Technicians	June 2003
The Demand and Supply of Skills in the Food Processing Sector	April 2003
National Survey of Vacancies in the Private Non-Agricultural Sector 2001/2002	March 2003
National Survey of Vacancies in the Public Sector 2001/2002	March 2003
The Irish Labour Market: Prospects for 2002 and Beyond	January 2002
Labour Participation Rates of the over 55s in Ireland	December 2001
The Third Report of the Expert Group on Future Skills Needs - Responding to Ireland's Growing Skills Needs	August 2001
Benchmarking Mechanisms and Strategies to Attract Researchers to Ireland	July 2001
Report on E-Business Skills	August 2000
Report on In-Company Training	August 2000
The Second Report of the Expert Group on Future Skills Needs - Responding to Ireland's Growing Skills Needs	March 2000
Business Education and Training Partnership 2nd Forum, Dublin	March 2000
Business Education and Training Partnership Report on the Inaugural Forum, Royal Hospital Kilmainham	March 1999
The First Report of the Expert Group on Future Skills Needs - Responding to Ireland's Growing Skills Needs	December 1998

Notes

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