



Project Maths: Reviewing the project in the
initial group of 24 schools – report on school
visits

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1. Introduction and context

Project Maths commenced in an initial group of 24 schools¹ in September 2008. Over 200 schools had applied to participate in the project and the initial group of 24 schools is reflective of the range of all post-primary schools. Changes to mathematics syllabuses and their assessment at both Junior Certificate and Leaving Certificate were phased in with these schools over a three-year period beginning in September 2008, with associated changes to the examinations commencing in 2010 (LC) and 2011 (JC).

Teachers of mathematics in the 24 schools have been supported through professional development workshops conducted by the Project Maths Development Team (PMDT) of Regional Development Officers (RDOs) and through complementary evening courses, with school-based support from the RDOs over the same period. The PMDT developed a range of teaching and learning support materials for teachers and students, which are published on their website (www.projectmaths.ie). The NCCA also developed student resources for the initial school group and these are now available to all students on the updated Project Maths pages of the NCCA website (www.ncca.ie/projectmaths).

A series of ten workshops, to which all maths teachers in the 24 schools were invited, focussed on the changed teaching and learning approaches advocated under Project Maths. Attendance at these workshops was consistently high – often in the 90%+ range. The workshops used specific topics from the different syllabus strands to illustrate a more investigative approach to teaching, learning and assessment and to emphasise the development of student problem-solving skills. The changed emphasis and approach to teaching and learning were also reflected in the examination papers for successive cohorts of students.

The complementary courses, including a series of summer courses by the National Centre for Excellence in Mathematics and Science Teaching and Learning (NCE-MSTL), addressed areas of mathematics content where the need for support had been identified by teachers and/or the support team. Over 2,000 of almost 6,000 maths teachers nationally attended the complementary evening courses, which were held in local Education Centres. Each year, close to 100 of the approximately 230 teachers from the 24 initial schools, attended the summer courses held in 2009, 2010 and 2011.

¹ In preparation for its amalgamation in September 2011 with another school that was not one of the initial group of schools, Abbey Community College, Wicklow aligned itself with the national roll-out schedule from September 2010. Nonetheless, maths teachers from the former Abbey Community College were included in this review exercise.

Over the period of the project to date, the NCCA has had limited direct contact with the initial 24 schools. The main contact has been the RDO team, who visit the schools on a regular basis to provide individual and group support to maths teachers. Following the selection of the 24 schools in May 2008, regional meetings were held for maths teachers in these schools to outline the project and the planned programme of support. In December 2008 NCCA held a meeting of the 24 school principals to discuss progress and to identify particular issues that needed to be addressed. In May 2009 NCCA convened a meeting for principals/deputy principals and one or two maths teachers from each school, at which the feedback obtained through a teacher questionnaire was presented and discussed. This feedback resulted in adjustments to the initial syllabus drafts for the following year. In subsequent years, NCCA contact with the schools has mainly been in the form of regular Information Notes for teachers, and attendance by NCCA personnel at a selection of workshops in the different regions.

Now that the maths teachers in these schools have completed the set of ten workshops, and some changed syllabus strands have been through a full cycle at both Junior Certificate and Leaving Certificate, the opportunity was availed of by the NCCA to renew direct contact with the 24 schools in order to get teacher feedback on their experience of the process of change that Project Maths introduced and the impact it is having on their teaching practice.

This report presents the feedback that teachers gave in the series of school visits by NCCA personnel to the 24 schools in the period December 2011–January 2012.

2. Meetings with maths teachers

2.1 Arranging and conducting the meetings

The arrangements for the school visits were agreed with each school and the relevant RDO. The December Information Note (see appendix, page 26) to the schools outlined the purpose of the meetings with teachers and the main focus points:

- the impact of Project Maths on their practices as a maths teacher
- the impact of Project Maths on the school's maths department
- the impact of Project Maths on their students' experiences of maths.

By agreement with the schools, these meetings were limited to two class periods. While it was not possible to meet with all of the maths teachers in each of the schools, as many teachers as possible were included in the meetings that took place. In some schools, which had a small number of maths teachers, all of them attended the meeting. In a few schools, two meeting sessions were arranged so that disruption to class schedules was minimised. While principals were invited to attend the meetings, none did so. In a small number of schools the deputy principal, who was also a maths teacher, attended the meeting. In all, over 150 maths teachers attended the school-based meetings in the 24 schools.

Each of the review meetings was conducted by one of the NCCA's Project Maths personnel, who was accompanied by the RDO who normally works with that school. Teachers were assured of the confidentiality of the process; no one teacher or school would be identified or associated with particular comments. A series of question prompts was used to which the teachers were asked to respond and their responses were recorded on flip-charts. Teachers were free to amend or elaborate on the recorded responses, or to re-visit earlier responses in light of later discussion. They were informed that their responses would be collated and analysed, with feedback to be given to the schools at a general meeting later in the year. They were also informed that a report on the feedback from the teachers would be presented to the Council of the NCCA and would inform any further refinement of the syllabuses being finalised for national roll-out in September 2012, when all five strands would be in place for all schools.

2.2 Focus questions

The main areas of focus during the school visits were as follows.

1. **The impact of Project Maths on teaching, learning and assessment practice in mathematics classes**

Teachers were asked to consider their classroom practices prior to the syllabus changes and at present, and also to consider what elements of practice they saw, and now see, as most valuable. They were asked to consider what forms of assessment they previously used, and now use, to assess student learning and progress in mathematics.

2. **The tools and resources that teachers find most beneficial**

Having identified these resources, teachers were asked to elaborate on why they valued them.

3. **The impact of Project Maths on the school's maths department**

As with individual teacher practices, they were asked to consider the functioning of the school's mathematics department (i) prior to the syllabus changes and (ii) at present and also to consider what aspects of the maths department and its role they saw, and now see, as most valuable to them as teachers.

4. **The impact of Project Maths on the student experience of maths**

Teachers were asked, from their perspective, to identify the most significant change for their mathematics students as a result of Project Maths.

In addition, teachers were invited to give feedback on the syllabuses, focusing on strands 3, 4 and 5 (dealing with number, algebra and functions respectively). To facilitate written feedback on this item, a template was included as part of the Information Note sent to schools in advance of the visit (see Appendix, page 26).

3. Collating the responses, identifying themes

When all of the visits were completed, the sets of teacher responses were reviewed to identify emergent themes across the various focus points. The process of analysing and collating the feedback is set out below, together with the main themes to emerge from this feedback.

3.1 Thematic Analysis

The analysis of the feedback from teachers in the 24 schools was undertaken independently of the NCCA team involved in conducting the meetings. All responses gathered from all sessions in the 24 schools were reviewed through a process of data coding. First order coding was a descriptive level of coding and involved organising and categorising the views expressed by the teachers. Since, in many instances, teachers' responses related to more than one of the focus points, second-order coding was used to combine the descriptive first-order codes into meaningful super-ordinate codes. Finally, overarching themes emerging from the data were identified.

3.2 Overarching themes

Theme 1 – New roles

Across the board, there was recognition from teachers that participation in Project Maths calls for a change in the roles of the teacher and the student.

We taught in the same way we were taught at school, and now it's different.

It was book led – all about ticking off chapters; rote learning, with the result tested in the exam.

You just told them that's the rule and they have to learn it.

Before, teaching was very much exam focused.

Teachers recognised that the student now needs to be a more active learner, becoming involved in activity and discovery learning through new classroom practices such as group work, questioning and discussion. However, teachers reported struggling with this new role, which requires using a new skill set and a new set of classroom practices to enable learning for their students.

I am uncomfortable about this new role, there is an unknown.

You are now a facilitator of learning as opposed to a giver of knowledge - I struggle with that.

Teachers voiced fears that their own lack of confidence with the new approaches under Project Maths is picked up on by students.

I had more confidence – I knew the full story; the exam reflected teaching and there was predictability for both student and teacher.

Now, students have less confidence in that they don't know what is expected of them in the exam.

Some teachers described how students are gaining a different type of understanding in this new learning environment; this is especially true for the more junior classes. However, the feedback from the meetings indicates that, as exams approach, students and teachers value the old ways and there is a pressure to ignore their new role and to revert to previous exam preparation techniques rather than focusing on learning.

In the long run, it is a positive process and kids can see the relevance of maths to their lives. It was hard at the start, but once everything settles down I wouldn't go back.

It used to be very easy to prepare for the exams using repetition of practice and exam-style questions. We miss the comfort of past papers.

In sixth year maths you are pressurized and fall back into the old style of teaching under pressure; the reality is that there is a Leaving Cert that determines children's futures.

I am trying more to teach the maths, but at certain times of the year it's just the exams that I concentrate on.

Theme 2 – Supporting the changed approach; using resources

Teachers emphasised that they need support and resources to assist them in developing the skills and knowledge required for their new and different role. They are learning and developing and there is evidence of their being at different stages on this learning continuum; some have undergone major changes, some are still at the start of this development. As they learn, confidence grows.

I have so much learning to do (teacher doing HL after a gap). I'm still not in the comfort zone with strands 3, 4 and 5.

My methods have totally changed since Project Maths came in.

We're going a little slower. I find we're constantly changing because it might work with one group and not another. I find we need to use different methods for different groups; this is the way it should be, not making one method fit all.

I have had to look at maths myself and it's made me improve my teaching practice; it's made me think outside the box.

It is clear that teachers value and need support during this period of learning and development. However, their comments suggest that over-dependence on various forms of support may become an issue. As more resources become available there is a danger that teachers may lose sight of how intrinsic they are to the change.

There are so many (resources) but they're a bit all over the place. The problem is they are coming in dribs and drabs. (We need to) have resources together digitally in strands.

All the resources are great but (students) still expect us to have all of the stuff in paper in front of them. The RDO is the saving of us.

We struggle to be able to make up questions ourselves; we need the resources of past papers.

I can't wait for the definitive book to be produced. I don't care how big it is, I want it.

Teachers cited collaboration as being valuable to them. They reported that within schools and maths departments there is much more collaboration and support between colleagues than before. It was noted, however, that much of this 'team' work takes place in informal collaborations and that collaborations need to be planned for and supported by the school administration. The issue of time for planning was a recurrent theme and will be dealt with in more detail later in this report.

There is more interaction between teachers and the focus is on maths approaches.

Before, everyone was king of their own castle; now everyone depends on each other.

Sharing means we are learning how to change and it gives us different insights.

Project Maths emphasises student understanding of concepts. There is evidence that teachers need support in making connections within mathematics. They recognise this ability to connect as an advanced skill that only develops after a period of immersion in teaching with the revised syllabuses. It is apparent that being confident in maths supports this identification of connections and their efficient use.

I didn't tend to link topics, but I see that there are more connections between all the strands now.

(Identifying) linkages between strands is challenging, as we didn't really see the linkage at the beginning. We learnt it as we went through and this makes teaching it more difficult.

I am starting to make connections across strands and able to say 'do you remember that we did this at (a certain time)?'

More time is spent on linking different topics together now.

I've learned loads. I never thought of linking slope the way I do now.

I put greater emphasis on several approaches to solving a problem rather than on a singular approach.

Teachers reported that engaging with Project Maths had a positive impact on their teaching approaches in other subject areas. There was a concern from teachers whose first subject was not maths that they were not familiar enough with the maths to teach in the new way.

Business is my subject (but) I don't have the subtleties needed for maths. I have to think about it and engage lots with the material to get that confidence. I am a better business teacher now because of my experience with Project Maths.

There is evidence that the syllabus is now seen as a useful resource and some teachers are becoming less dependent on text books. However, they report that their students value the textbook and they feel under pressure to use the text books in class.

We read the syllabus (now). We have more understanding of the syllabus.

You have a copy of the syllabus in your back pocket now. Before, the book was the syllabus and you followed that.

Trouble is, they (students) respect the book, not worksheets.

They are used to having a book and perceive that it is not a real lesson without it. Having a textbook is a serious advantage – good kids are used to it from other subjects and weaker kids get structure from it.

Some comments point to the need to provide support in interpreting a syllabus now that it is written in terms of learning outcomes.

We had a syllabus that made sense, we didn't have these statements. I don't know the syllabus well and I'm not able to direct students to exams.

The syllabus is too vague; we may be over-teaching some topics and not emphasizing enough in other areas. The (text)book was easy – this isn't.

When asked about the resources they have used and valued teachers cite practical activities, resources and equipment that they have developed themselves or have been provided with through Project Maths. They also commented that having all the necessary materials and resources was challenging.

We need to use hands-on, open-ended activities.

The T& L plan is good – (doing) probability by making a game; statistics through doing their own surveys and presentations.

We did a school census. I used a newspaper article about statistics as a discussion.

(I'd) like to be in a position to have a set of maths equipment in the class; it's very useful to have and getting them is difficult. If we had these on a shelf it would be very helpful. Maths classes need resources like other practical subjects: dice, cards, spinners, geostrips, probability kits; this must be taken seriously.

In almost every school, teachers reported an increased use of IT and this too is valued.

IT is valued because, for example, geogebra allows visualization and very quickly aids understanding. It is good for constructions, graphs, and seeing what differentiation does.

(Students) are used to technology. It brings the maths home to them and they want to do it themselves.

The internet is great, but it is time consuming to get 'tailored material' – one size doesn't fit all and you have to rework it for different classes. It takes a while to gather a portfolio of resources.

Some teachers report that they find group work useful.

In group work you encourage students to learn themselves, making mistakes.

Highly motivated students benefit more from the approach of group work and open-ended activities.

Other teachers report on the challenges that they experience with group work.

In some classes discipline is a problem and this means you can't do group work and things like that.

There is not enough time for it (group work).

(The) effectiveness of group work depends on the size of the group, the ability/nature of group and the motivation of the group.

There's a higher percentage of demotivated kids in OL so I think group work is not suitable with these kids.

Teachers report that they are using questioning and discussion more frequently but, like group work, learning how to use this new learning methodology effectively is a challenge.

It's very difficult to get them to engage; they're not comfortable about sharing solution strategies; some are afraid to give their own opinions.

Sometimes I am met with silence and I end up answering it myself.

No time for this. I can't spend hours on a question and if you can't keep them on task it's disruptive and you'd lose a lot of them.

Questioning gives them an understanding of the vocabulary.....It's brilliant, you know from that that your message has got across.

Teachers had mixed opinions on the value of using open-ended tasks and activities to support learning. Some reported that using open-ended tasks is time consuming and there is evidence that, once again, teachers and students need time to learn how to use these effectively. Some see open-ended tasks as an add-on activity, not a core teaching methodology.

Open ended tasks and activities take time to prepare. It frustrates the hell out of them; depends on their ability weak (students) can't break it into pieces.

(Open-ended tasks) perceived as a doss class by some kids who complain that teachers are not explaining it.

Better able kids can come up with strategies.

With problem solving there are lots of ways of skinning a cat – some of them only want one way of doing something.

Many teachers cite pressure from, and the dominating presence of, the terminal examination (Leaving Certificate) as inhibiting them from using the more student-centered methodologies such as open-ended tasks, discussion and group work.

Ultimately, (the) written exam is the thing, they have to do one – very bright kids answer questions very well in class but fall down in exams.

In class you can use questions to open up a problem but in the exam they need to be able to do this themselves.

I am trying more to teach the maths but at certain times of the year it is just the exam; we want to approach things in Project Maths style but we fail under pressure of exam structures.

Teachers report school issues such as classroom layout, maths-based classrooms and timetabling as being important to them in supporting the changes.

Theme 3 – Issues of assessment

It is clear from comments by teachers that there is still a heavy reliance on 'tests' as a way of assessing learning. There is evidence that teachers need help and support in developing new and trusted ways of assessing, adopting an approach which is reflective and focused on learning, assessing the extent to which learning has been achieved, and refining their teaching to reflect this.

When asked about the methods of assessing student learning that they value most, teachers reported that tests, exam questions and homework were the primary ways they were assessing learning.

Tests – assess each individual; they (students) have to be used to a written test.

Exam questions and end of topic exams (are) most beneficial, and give practice for the final exams.

(Tests) allow you to test a variety of concepts. You get to see where they are going wrong.

The only way to check homework is by giving a test.

I put more maths questions on tests to get them used to the unexpected.

You know it's their own work and it is the way that they will be tested. All the resources are great but the homework and questions are the bread and butter.

(Students) don't record enough when they're doing investigations.

(Checking homework) gives a fair idea which ones (questions) were the problem, then open forum as to what was the problem and discuss to solve the problem.

Swapping homework, marking each other's (work).

However, even with tests, some teachers find it difficult to adopt a changed approach in marking student work.

I haven't a clue how to mark tests; I still use old scheme: +3, etc. Even with mocks I can't decide where marks should be awarded, or what constitutes 'appropriate information'.

We need an inservice on marking students' work. I would like to see how a 'fair scheme' for marking works.

If you are trying to be innovative, you can't give predictable homework.

There is some evidence that alternative assessment methods such as project work, assignments, open discussion in class, questions, and examination of students' work are being used, but some teachers expressed the need for support on how to use these methods effectively with all their students.

(I use) discussion in open forum, getting them to describe the steps to answering the question.

They can look at a question and just think "I can't do it". Some students could sit there doing nothing... They need prompts: Explain how you got there? Elaborate on..., Why did you start with that...?

I got my students to make their own questions and give them to each other but I didn't know if that was worthwhile.

Individual white boards are useful, you can quiz all students at the same time – it's efficient; they get feedback straight away.

We use a folder system; students keep all their work and get graded on it.

I listen in on their discussion, absorbing what they are answering.

Sites such as ixl.com for online assessment (interactive assessment) give students feedback. A lot of students don't see this as homework. They know the teachers can log in and they are competitive.

Teachers' comments about their experiences with different approaches to assessment reveal that in some cases the thinking about the purpose of assessment is beginning to change.

Formative assessment – it's different, gives you different insights and you can engage with them as you move forward.

Extra work/ revision stuff and their attempts inform you.

Use students' work to illustrate different solutions – that is useful.

Students presenting work and explaining (their) strategy is great because it gives them confidence, they see different ways. If I just show them it gives preference to my thinking. (This way) shows them I am not an expert. I enjoy listening to their ways.

Teachers have concerns about how well the new teaching methodologies and assessment are supporting the diverse learning needs of their students.

There is too much English on the paper. I worry about foreign students and those with weak language ability to interpret questions in an exam. The lack of help and resources for these students is becoming a bigger issue.

Assessing the ability to display understanding of maths is an issue.

Students with SEN – if they can't get info out of the question then they are at a disadvantage.

Teachers have concerns about the exams. Currently the exam is impacting on the new teaching and many teachers feel under pressure to revert to old style 'drill and practice' teaching and abandon student-centered, inquiry-based methodologies. Teachers voiced concerns about the length, structure and format of the examination papers and wondered whether they adequately assessed the learning on Project Maths.

Exam papers are too long. There is a lack of structure in the (new) exam papers. (Before this) you could always say if you do this and this you'll get attempt marks, but now you can't.

I feel sorry for them when we give them Project Maths questions; they don't get a sense of reward or achievement, they are fine working through the resources but then they can't equate what they are doing with exam questions

Project Maths needs project-based assessment...there is a need to change the way it is examined.

The exam is unpredictable; there's no (a), (b) and (c) parts anymore.

Some of the exam questions are unfair, you might not be able to start a question whereas before you knew there were questions that everyone could do.

I feel I'm engaging more kids in the class, they enjoy maths more, but they're still not doing well in tests. (LC) students can problem solve but can't do papers.

Teachers cite fear and anxiety around exams as a feature of the student experience of Project Maths.

5th and 6th years are fearful, it's a negative experience.

5th years who haven't been through Project Maths can't problem solve – they find it daunting. HL 5th years who engaged with Project Maths in JC are anxious about the LC because they got negative vibes from the last 6th years and are not as confident in the teacher's ability to deliver.

Theme 4 – Time

This theme is constant throughout the Project Maths experience. Teachers made points about time to meet and plan. They mentioned time in relation to covering the course and using problem solving methodologies. They mentioned time being needed to use different kinds of assessment.

Involvement, discussion and activity learning are more time consuming than 'chalk and talk'. We don't have time to explore.

You can't afford the time for the hands-on stuff even though the kids enjoy it and get it.

In senior cycle I don't have as much time to show them things, whereas in JC you have more time to go through the explanations, investigations and discovery.

We need time to teach for and to develop understanding.

Teachers reported that time pressures inhibited student-centred approaches to learning.

Due to the length of the course I'm teaching new material in the old way – drill and practice – it's a time issue.

In 6th year maths you are pressurized and fall back into the old style of teaching.

Time pressure to get the course done reduces time for questions.

It was also recognised that it takes time to become familiar and confident with the new syllabus and teaching methods, and teachers report that they find it difficult to know how much time to spend on each topic.

I need to be comfortable knowing how much time is available for a topic before I am willing to do the playful stuff.

How much time to spend on certain topics is still an issue.

There is a perception that the syllabus is long and time consuming and that it takes teachers longer to teach the same thing. There is evidence from some teachers' comments, however, that as teachers develop their familiarity with the connections between strands they can make more efficient and effective use of their time.

Strands 3 and 4 (take) too long to teach.

The HL course is too long; every day you do something new and there's no time to go over stuff.

The new course is longer, with more material, more depth; we are being asked to teach more to a greater level of understanding.

A small section on the syllabus may take a long time to cover.

Now I spend more time linking different topics together.

There is greater emphasis on several approaches to solving a problem rather than just one way.

Cross-linking, not going chapter by chapter, and looking for different representations takes more time.

There were reports in a small number of schools that teachers are teaching exam classes outside core school hours to cover the syllabus. It was acknowledged that this has lessened as the phasing of Project Maths progressed.

I need 240 hours to come at it (the syllabus) from different perspectives.

I came in after school 2 days a week in the first year. I didn't want to encourage panic and I knew this way we would cover the course.

I'm terrified of not getting the course covered; you can't get sick or you won't get it covered – that wasn't the case before.

Teachers reported that timetabling needs to support the maths learning needs. They also emphasised the pressure that exams exert on how time is used for learning.

35 minute periods are a constraint to new practices. Field work and practical work take more time.

5 class periods are proving inadequate for 5th and 6th years, given that 3 out of 5 classes are the final class of the day.

If maths is to become hands-on it should be treated as a science (a practical subject) with 24 students per class; the ability range in classes is huge.

I am concerned about the time element, it takes more time to get a topic covered and will that be reflected in the paper? I have to finish (the course) by Feb/March because of mock exams.

No revision time any more – 6th years are going into mocks to do material they haven't done since last year.

As noted already, teachers felt strongly about the need for time to be made available for planning and collaboration.

I spend more time preparing and thinking about methodology.

Maths teachers are involved in other (subject) departments, so can't always meet formally.

We have a class a week to meet...but I know we are only getting all this meeting time because we are a pilot school.

We're not allowed to use the Croke Park hours, we've agreed on 1 hour a term for subject planning, but this is inadequate.

We underestimate what time different methodologies require and the amount of preparatory time required, e.g. group work is more than just putting people into groups and throwing stuff at them.

Theme 5 – Issues of change

Teachers have views about the manner in which Project Maths was introduced simultaneously in first year and fifth year. Many of them felt that the exams were unfair to their students. For some there is still a sense that they don't have ownership of the change. The manner in which Project Maths issues are dealt with in the media impacts on teachers' perceptions.

There has been a lot of change in a relatively short time...Maybe it should have started only with first years.

You're always having to justify (to students and parents) anything you do that's different as people don't like change; they will blame Project Maths for not doing well in maths.

When the first cohort of students went through the exams there should have been more consultation.

(We feel) the feedback we gave in June about the exam was ignored.

We feel that we're being used as a test – every other school benefits – and that we're guinea pigs.

Some of the kids have lost faith. The experience over the first couple of years was stressful for students and still is; they are afraid.

The exam last year upset people, especially the students; they lost confidence. It has a lot to do with papers, poor publicity in the media.

Theme 6 – Syllabus content issues

Teachers made a number of general points about strands 3, 4 and 5 along with other aspects of course content and its assessment. These are summarized in Table 1 below. Their comments suggest that teachers need support in understanding the aims of the syllabus, how to interpret learning outcomes and the purpose of assessment.

Table 1: Specific comments made by teachers about the syllabus

<p>Strand 3</p>	<p><i>Generalising a quadratic relationship from a pattern is very difficult, they cannot get the formula. This turned them off patterns.</i></p> <p><i>I'm happy with identifying a pattern as quadratic and continuing the pattern...but it's a step too far to generalize this.</i></p> <p><i>Manipulating equations is nightmarish stuff when they have to do procedures – a lot of procedure has gone – they need a balance.</i></p>
<p>Strand 4</p>	<p><i>Strand 4 is most enjoyable, and provides lots of linking. The different syllabus levels are appropriate.</i></p> <p><i>Connections - 5th years are actually making connections between different strands and previous work.</i></p> <p><i>LC - algebra is wider. The 3 nested columns leaves a lot to cover.</i></p> <p><i>Strands 3 & 4: patterns and algebra are better connected now.</i></p> <p><i>Standard question algebra style at JC-HL, formulas, etc.</i></p> <p><i>There is a huge jump from JC-HL algebra standard of the sample paper to that required to study at LC-HL. Problem solving in algebra is a problem...kids are used to algebra as patterns.</i></p>
<p>Strand 5</p>	<p><i>Differentiation is too short; product, quotient and chain rules are gone, differentiation from first principles is gone, this was always a comfort to the student; they could do it.</i></p> <p><i>Calculus is a complete change; it's lovely because now it's more applicable, trig the same. Before it was all rules, rules, rules.</i></p> <p><i>I am disappointed by the amount of integration on LC-HL.</i></p>
<p>Foundation</p>	<p><i>FL syllabus is needed at JC.</i></p>

level	<p><i>It's not all about OL and HL and 3rd level; we must think of FL – they are aground completely, with no questions directed for them.</i></p> <p><i>There is a serious lack of understanding for FL – it needs to be more tightened/specific. It's vague - what depth for FL?</i></p>
Common Introductory Course (CIC) in First Year	<p><i>Not sure whether the CIC material is working.</i></p> <p><i>The CIC is so broad and, for good students, it's not challenging enough. I don't know whether they gain anything.</i></p>
Comments on exams	<p><i>Paper 2 is too long.</i></p> <p><i>It's difficult to judge the syllabus without a selection of exam papers to see how it is examined.</i></p> <p><i>The a, b, c structure for questions was better.</i></p> <p><i>There needs to be a hint to help students identify the differentiation question.</i></p> <p><i>Top students are unnerved – for some questions they require life experiences beyond their years.</i></p> <p><i>Title the question – the words make it difficult to know which section this is. There is a need to read and comprehend.</i></p> <p><i>There is a serious language issue – students ask 'Is this an English test or a Maths test?'</i></p>

Note: Teachers comments on specific learning outcomes and other queries on the syllabus were brought to the attention of the relevant course committee. Some additional clarifications are being made in the syllabuses to be issued in September.

4. Learning from the experiences of the 24 schools

The teacher feedback above indicates that the teaching of maths in these 24 schools is changing, albeit at a slow pace, as a result of Project Maths.

For many teachers there has been a change in their role, teaching practices and methods as they have moved away from teacher led and didactic approaches to more student-centered and active methodologies. Many teachers now see themselves as facilitators of learning rather than givers of knowledge. This change has not been easy and many teachers have described a loss of confidence when compared with their familiarity with the previous syllabus and exam. They have also described being very challenged by the increasing time demands of the new syllabus. Using active learning methods, characterised by a higher level of student involvement, classroom discussion and practical work, has proved very time consuming so far and many teachers have reported that covering the whole syllabus is challenging. Some teachers reported that they taught extra classes outside core maths hours to complete the syllabus.

Learning approaches such as group work, classroom discussion and questioning are being used by more teachers. All teachers report that these methods are more time consuming than 'chalk and talk' and 'drill and practice' methods, and many report that they are challenging to use as not all students are yet comfortable with them. Teachers have indicated a need for support to enable them and their students to develop the skills to use these methods efficiently and effectively. Not all teachers are convinced that these teaching practices offer additional learning benefits over the 'chalk and talk' and 'drill and practice' approaches that they have relied on in the past.

While embracing new approaches in their teaching, many teachers still focus on the examinations, particularly in sixth year, and want more exam-focused questions and sample papers to use in exam preparation. The practice of striving to finish the full syllabus in time for early mock exams adds additional time pressures. Some teachers have reported that they have reverted to 'chalk and talk' teaching methods under these time pressures in sixth year. From teachers' comments, there would appear to be some danger that, with increased availability of exam-oriented resources, they may revert to old practices and not fully embrace their new role.

Teachers report that increasingly they are using the syllabus as a guide, whereas previously they had used the text book and past exam papers to guide their teaching. However, not all teachers report being comfortable with the language and level of detail provided by the syllabus. If the syllabus is to be a useful guide, then teachers need to be

able to read and understand it and it has to be more than simply a list which is ticked off when a topic has been 'covered'. Reading and understanding a syllabus and using it to design learning activities that 'fit' the group of students in a class appears to be an important competency for teachers, and an area in which teachers expressed the need for support. This is also a challenge for the NCCA in syllabus design and development.

Collaboration among maths teachers in each of the schools has increased. While most of the schools did have maths department meetings prior to Project Maths, these tended to be more focused on timetabling, exams and sequencing issues. These meetings are now increasingly focused on collaboration around challenging aspects of teaching the syllabus using the new approaches. Teachers report having more meetings and, in particular, more informal meetings, which are often between two or three colleagues and focused on maths. This collegial support has been found to be very valuable by all.

Teachers believe that the student learning experience has changed. They report that students are now engaged in greater discussion, collaboration and activity within their maths classrooms although, as has been reported above, this often changes under the pressure of the exam year. Teachers also report that not all students are comfortable with this new type of learning and it appears that younger students and those not in exam years are most comfortable with the new methods, whilst exam year students are disconcerted by the absence of past exam papers and want teaching geared to answering exam questions. On the other hand, teachers do report that there has been an increase in understanding maths concepts among students. Students who performed best in the previous 'chalk and talk' and 'drill and practice' learning environment seem to be more challenged by the move to discovery learning and those who were less able in that environment are now performing better.

Another area where teachers need new skills, and support in developing these skills, is the area of assessment. It appears that the majority of teachers used, and many still continue to use, tests as their only assessment tool. The experience of some teachers who have attempted to explore other assessment methods is that it can be challenging. There is some evidence of the insight that teachers have gained into students thinking and learning through changed classroom practices, such as listening as students explain how they solved a problem, or group discussions on different ways of answering a question. These insights can change teachers' perceptions of student understanding and learning, and also change their perceptions of the efficacy of the newer teaching and learning practices.

It appears that the changes introduced by Project Maths propel both teachers and students on a new learning continuum. Not all teachers are at the same point or proceeding at the same pace along this continuum. From the meetings held in the schools, it would appear that experienced and fully qualified maths teachers who are teaching maths full-time have found the experience of introducing Project Maths less challenging than their colleagues who teach a range of subjects. These teachers have often been able to provide peer assistance to their colleagues and have been an internal source of support within maths departments, which has facilitated collaboration between teachers.

A range of concerns have been voiced about the changed Leaving Certificate exam. Some teachers are worried that it doesn't reflect the type of learning that Project Maths promotes and that there should be a move towards an additional assessment component, such as project work. Others have focused more on issues of exam performance and perceive that students who would previously have got an A1 in maths are now not achieving this high grade and they consider that this is a problem with the exam rather than a reflection of student learning and understanding. Other exam-related concerns include issues of reward for effort through the year, in that a lot of time may be spent teaching a concept that then doesn't feature specifically on the exam.

The experience of these 24 schools has demonstrated that teaching using the approaches in Project Maths is only the starting point in changing the culture of maths teaching and learning within a school. The new syllabus is only one element in this transition. Ongoing supports for teachers, a collaborative maths department, organised and accessible resources, a timetable that supports a discursive learning environment, a classroom infrastructure that supports this type of learning, an assessment methodology that reflects the syllabus learning outcomes, and methodologies and external leadership and support from the educational establishment all have an important role to play. Indeed the experience of the 24 schools to date demonstrates the synergies between these.

Across Europe, it is recognised that professional development opportunities can play a key role in equipping all teachers with the necessary skills to adapt their teaching to changes and developments in mathematics education (*Mathematics Education in Europe: Common Challenges and National Policies*; a report of the Eurydice network, 2011). The report acknowledges the specific reforms in Ireland which target mathematics teachers – one of only two countries where such reforms have been introduced.

5. Next steps

The feedback from the schools will be discussed with the Project Maths Development Team, with a view to planning future support for these schools as they complete the full cycle of changed examinations.

The maths committees were kept informed of emerging issues in relation to the syllabuses and their assessment. From September 2012, all schools nationally will engage with the same syllabuses. This will see the final section of the 'retained' syllabus being replaced by strand 5 (functions). In light of the fact that some topics in this section of the LC Maths syllabus will no longer be included, the committee decided not to make any additional adjustment to the length of the syllabus at this stage. As students come through to senior cycle having experienced the revised syllabus and new approaches in the junior cycle, future consideration of syllabus length will be informed by ongoing feedback from the initial schools.

A seminar involving the principals/deputy principals and two maths teachers from each of 24 schools will take place in April, at which the overall findings of the feedback from the school visits will be presented and discussed.

Appendix



Project Maths Information Note #14 December 2011



Please ensure that all maths teachers in your school receive this bulletin.

This Information Note provides details about the upcoming Project Maths review meeting in schools.

Project Maths school-based review meeting

One of the NCCA Project Maths team together with your RDO will be visiting your school in the next two weeks. The purpose of this visit is to get feedback from you on your experiences of the Project Maths initiative. On the day of the visit we will be meeting with maths teachers for two class periods; the meeting will be informal and we intend to cover the same ground with all schools. The main focus of the session will be:

- The impact of Project Maths on your practices as a maths teacher
- The impact of Project Maths on your school maths department
- The impact of Project Maths on your students' experience of maths.

Feedback on strands 3,4 and 5

We will also be looking for your feedback as initial participants in the project on strands 3, 4 and 5 so that the committees can consider this before they finalise the syllabus for national roll-out in September 2012. In order to direct your thoughts, and in the event that we are under pressure with time on the day, we would ask that you note any comments on strands 3.4 and 5 in advance of the meeting on the sheet provided. We will take this away with us for discussion with the committees.

NCCA contact details

Contact details for NCCA staff working on Project Maths are set out below.

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Strands 3,4 and 5

The four main headings under which we would like to get your feedback are:

- The syllabus topics and learning outcomes
- The appropriateness of the different syllabus levels
- The progression from JC to LC
- The connections between the strands