Report

First interim report for the Department of Education and Skills and the National Council for Curriculum and Assessment

Research into the impact of Project Maths on student achievement, learning and motivation

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Executive summary

The National Foundation for Educational Research (NFER) has been commissioned by the Department of Education and Skills, Ireland, and the National Council for Curriculum and Assessment (NCCA), to explore the impact of Project Maths on student achievement, learning and motivation in:

- the initial post-primary schools (phase one schools), which introduced the revised mathematics syllabuses in September 2008
- post-primary schools (non-phase one schools), which introduced the revised mathematics syllabuses in September 2010

This first interim report presents the key findings arising from the first two elements of this research, drawing on the findings of **an internationally comparable assessment of student achievement** and **survey of student attitudes, motivation and confidence**, administered to Junior Certificate and Leaving Certificate students in Spring 2012.

About the students

This part of the research involved phase one and comparison group students at Junior Certificate level, and phase one and non-phase one students at Leaving Certificate level, all of whom were in the examination year of 2012. They were, therefore, reaching the end of their studies at the time of participating in the research.

As the revised mathematics syllabuses are being introduced incrementally in schools, this cohort of phase one Junior Certificate students had studied Strands 1-4 of the revised mathematics syllabus. The same cohort of students in non-phase one schools had followed the previous mathematics syllabus introduced in 2000, and was therefore included as a comparison group for this research.

Phase one Leaving Certificate students had studied all five strands of the revised mathematics syllabus. Students in non-phase one schools were part of the first national cohort of the revised mathematics syllabus. These students had followed revised syllabuses for Strands 1 and 2, and for the remainder of their studies had followed the previous mathematics syllabus. Whilst they were not, therefore, a comparison group, students in this group had been less immersed in the revised syllabus than their phase one counterparts.

Key research findings

Assessment of students' achievement in mathematics shows that, overall, students are performing well in many aspects of the revised mathematics syllabus, and there are many parallels between students' achievement and their attitudes, suggesting that students are reflective about their experiences of learning mathematics, and able to identify their own areas of strengths and weaknesses.

Whilst the research does not reveal any discernible differences between the skills of students following the revised mathematics syllabus and their peers following the previous syllabus, students following the revised syllabuses reported that they are regularly engaging with a range of teaching techniques central to the aims of the new syllabus. This includes activities such as: the application of mathematics to real-life situations; making connections and links between mathematics topics; using mathematical language and verbal reasoning to convey ideas; and planning and conducting investigations.

Achievement of Junior Certificate students

Performance of phase one schools

In general, **students appear to be performing well in many aspects of the revised syllabus**. In relation to Strand 1 (Statistics and Probability) and Strand 2 (Geometry and Trigonometry), there were no items which students appeared to have found particularly difficult. Students also performed well on the majority of items relating to Strand 3 (Number) and Strand 4 (Algebra), although there were some specific items that students appeared to find more challenging. However, students showed a wide variation of abilities within each area of the syllabus, suggesting that students following the revised syllabus struggled with particularly demanding questions, rather than a specific topic or theme.

The performance of the students following the revised syllabus on the Junior Certificate item indicator booklets suggests that, in general, **items requiring higher order skills (such as reasoning and an ability to transfer knowledge to new contexts) are found more difficult** than those which are more mechanical in demand.

Comparison of student performance between phase one and comparison group schools

The **performance of students following the revised syllabus and those following the previous syllabus at Junior Certificate level is similar**. Whilst, in general, students following the revised syllabus performed better than their comparison group peers, this difference is only statistically significant in relation to a particular item which explores students' abilities in Strand 1, Statistics and Probability (assessing students' understanding of the outcomes of simple random processes).

Whilst it is encouraging that Junior Certificate students are performing well, it is reasonable to conclude that engagement with the revised syllabus has not yet positively or negatively impacted on the performance of students following the revised syllabus at Junior Certificate level relative to their peers following the previous syllabus.

Comparison of student performance with international standards

In general, students following the revised syllabus scored well on the majority of items in comparison to international standards. In particular, **these students have shown a strong performance on items assessing Strand 1 (Statistics and Probability)**. The high

performance of phase one students on the items in this strand is encouraging and suggests that the implementation of this part of the new syllabus is working well.

However, **students following the revised syllabus appear to find Strand 4 (Algebra), and 'Examining algebraic relationships' in particular, to be especially difficult.** Overall, their knowledge on subject areas relating to Strand 2 (Geometry and Trigonometry) and Strand 3 (Number) appear to be similar to that of students internationally.

Attitudes of Junior Certificate students

Students' experiences of mathematics lessons

The revised mathematics syllabus encourages approaches such as applying mathematics to real-life situations; conducting investigations; and participating in discursive and collaborative activities, such as group work. A high proportion of students following the revised mathematics syllabus **are regularly undertaking many of these approaches**.

Furthermore, in many areas, there was a higher proportion of positive responses from students following the revised syllabus than from those following the previous syllabus. This suggests that such approaches are being effectively translated into classroom practice. However, similarly high proportions of phase one and comparison group students reported that they regularly participated in activities aimed at developing their mathematical thinking skills, suggesting that the introduction of the revised syllabus does not appear to have had an impact on students' experiences in this area.

Although there are positive indications that the approaches promoted through the revised syllabus are being reflected in the classroom, there remains a high proportion of phase one pupils who report that **they participate in activities associated with more traditional approaches** to mathematics teaching and learning, such as copying what their teacher writes on the board and using textbooks in lessons. Whilst the reasons for this remain to be explored in subsequent phases of this research, it is possible that schools have concerns about the content and format of examinations for the revised syllabus, leading them to use more familiar methods of supporting young people to achieve examination success, whilst simultaneously promoting and delivering many of the features of the revised syllabus.

Students' attitudes towards learning mathematics

Both phase one and comparison group students were **broadly confident in their abilities in topics spanning all strands of the revised syllabus**. This was particularly notable in relation to Strand 1 (Statistics and Probability), an area in which students generally performed well in the assessment part of this research. Although the majority of students in both phase one and comparison groups reported that they were confident in relation to Strand 4 (Algebra), a lower proportion of phase one students reported that this was the case, relative to the comparison group. Again, this reflects the findings of the assessment phase. The reasons for this will be explored further during the case-study phase. For example, the

two groups may take different approaches interpreting this type of question, which could explain any differences in students' confidence.

Across all strands, **phase one and comparison group students were confident in their synthesis and problem-solving abilities**. Interestingly, however, phase one students appeared to feel somewhat less confident than their comparison group peers in solving problems based on real-life situations, despite phase one students reporting to have done so more frequently. One possible explanation for this is that, as phase one students do this more frequently than their comparison group counterparts, they have been encouraged to test out and challenge their skills in this area to a greater degree.

Students' attitudes towards careers involving mathematics

Both phase one and comparison group students were in broad agreement that **mathematics was important in a range of contexts outside of the classroom** (e.g. in daily life, and to enable them to access further education and jobs). The majority of students felt that mathematics was important for a range of career types including, for example, business management, accountancy, engineering, and retail. There were no substantial differences between the views of students following the revised syllabus and those following the previous syllabus. This suggests that the introduction of the revised mathematics syllabus has not, to date, had any discernible impact on students' appreciation of the application of mathematics.

Achievement of Leaving Certificate students

Performance of phase one schools

Student performance was mixed across the different strands of the syllabus. Overall, the results echoed those of Junior Certificate students, in that **items requiring higher order skills were found to be more difficult**.

A number of items required a multiple choice response followed by a 'show your working' section. Many students did not attempt to justify their answers, suggesting either that they were daunted by this request, or did not realise they needed to complete this section to be awarded full marks. This was surprising given the emphasis placed on this type of approach within the revised syllabus. Leaving Certificate students appeared to find items relating to Strand 5 (Functions) of the revised syllabus, relatively difficult, even amongst Higher Level students.

Comparison of student performance between phase one and non-phase one schools

The performance of phase one and non-phase one students was broadly similar on Strand 1 (Statistics and Probability) and Strand 2 (Geometry and Trigonometry), which is to be expected, as both groups of students had been studying Strands 1 and 2 of the revised syllabus for the same amount of time.

There were some indications of differences in the performance of the two groups in specific aspects of each strand, these tended not to span a whole strand. There were some indications that phase one students performed better than their non-phase one peers in **analysing verbal geometric information and translating it into mathematical form**. However, in other items relating to this area there was no discernible difference between the two groups.

Comparison of student performance with international standards

Phase one students performed much better than international students on many of the items relating to Strand 1 (Statistics and Probability) and Strand 2 (Geometry and Trigonometry), and the majority of these fall within Strand 1. The high performance of phase one students on the items in this strand is encouraging and suggests that the implementation of this part of the new syllabus is working well. In general, phase one students performed better than expected on items where the solution strategy is clear, and where diagrams, if applicable, are provided. They performed less well on multi-step items.

It is important to note that comparisons between the performance of students following the revised syllabus and the available international data are confounded by a range of factors, including differences in age, but provide some baseline indicators. Using this analysis as a baseline measure will enable comparative analysis of students following the revised syllabus with international performance in the subsequent stage of the evaluation.

Attitudes of Leaving Certificate students

Students' experiences of mathematics lessons

Leaving Certificate students gave a similar pattern of responses to their Junior Certificate peers, with a **higher proportion of phase one students reporting that they regularly engaged in activities promoted within the revised syllabus** (for example, applying mathematics to real-life situations; conducting investigations; and participating in discursive and collaborative activities). Again, although there are indications that the approaches promoted through the revised syllabus are being reflected in the classroom, there remains a high proportion of phase one pupils who report that they participate in more traditional teaching and learning approaches, such as **copying from the board and working from textbooks**.

Students' attitudes towards learning mathematics

Both phase one and non-phase one students **had similar high levels of confidence in items relating to Statistics and Probability (Strand 1)** which, as both groups have studied this strand, is a positive indicator of its impact on students. Students were also largely confident in relation to Strand 2 (Geometry and Trigonometry) and Strand 3 (Number), albeit to a lesser extent than Strand 1.

Although the responses of both groups were broadly positive in relation to Algebra (Strand 4), as with the Junior Certifcate, **phase one students appeared slightly less confident in**

using algebra than their non-phase one peers. Again, the reasons for this will be explored further during the case-study phase. Both phase one and non-phase one students were highly confident in relation to Strand 5 (Functions), although the phase one cohort had considerable difficulty with this strand in the testing part of the research.

In general, both phase one and non-phase one students reported that they were **confident to use mathematics to solve problems based on real-life situations**. Like their Junior Certificate peers, however, Leaving Certificate phase one students appeared to feel somewhat less confident than non-phase one students. As with the Junior Certificate, this may be because students following the revised syllabus have a greater understanding of the complexities of this type of activity as a result of doing so more frequently than their peers.

For Leaving Certificate students, unlike Junior Certificate students, there was a statistically significant difference between phase one and non-phase one groups in their confidence to synthesise what they have learned in more than one topic, and apply it to solving a range of mathematical problems, with non-phase one students appearing to feel less confident.

Students' attitudes towards careers involving mathematics

Like Junior Certificate students, both groups of Leaving Certificate students reported that mathematics was important in a range of contexts outside of the classroom, but shared their views regarding the scope and range of careers which may involve mathematics.

Many Leaving Certificate students (in both phase one and non-phase one schools) were planning to pursue further study and/or careers in mathematics**,** favouring professions such as accountancy and business management

Discussion and next steps

In Autumn 2012, a further round of attitude surveys and assessments of student performance will be conducted with Junior Certificate and Leaving Certificate students in the examination classes of 2013. This will enable comparisons to be drawn between year groups as the revised syllabus becomes further embedded and developed in schools.

1. Introduction

The National Foundation for Educational Research (NFER) has been commissioned by the Department of Education and Skills, Ireland, and the National Council for Curriculum and Assessment (NCCA), to undertake research into the impact of Project Maths on student achievement, learning and motivation in:

- the initial schools (phase one schools), which introduced the revised mathematics syllabuses in September 2008
- all other post-primary schools (non-phase one schools), which introduced the revised mathematics syllabuses in September 2010

This first report to NCCA presents the key findings of the first assessment of student achievement and survey of student attitudes, motivation and confidence, administered to Junior Certificate and Leaving Certificate students in both groups of schools in Spring 2012.

1.1 Background and context

Project Maths is a major national reform of the post-primary mathematics syllabus in the Republic of Ireland for both junior and senior cycles. Introduced in 24 phase one schools in September 2008, and rolled out to all post-primary schools in September 2010, Project Maths was designed to change not just *what* students learn about mathematics, but *how* they learn and how they are assessed. Project Maths represents a philosophical shift in Irish post-primary education towards an investigative, problem-focused approach to learning mathematics, emphasising its application in real-life settings and contexts.

A recent report produced by the Eurydice Network exploring the common challenges and national policies for teaching mathematics in Europe found that the use of such approaches is the focus of a number of European countries. Mathematics teaching and learning in all countries involved in the study feature problem-focused learning and, when applying mathematics to real life contexts, a wide range of approaches are taken. Some countries emphasise contexts which are familiar to students so as to provide a meaningful frame of reference for their learning (for example, this approach is taken in Spain, Poland and Italy). In other countries (for example, Estonia), students are encouraged to participate in outdoor learning, relating their mathematical knowledge to architecture and visual arts. Similarly, active learning and critical thinking is advocated in many jurisdictions (for example Belgium, the Czech Republic, Slovenia and Spain), encouraging 'pupils to participate in their own learning through discussions, project work, practical exercises and other ways that help them reflect upon and explain their mathematics learning' (Eurydice, 2011:56).

Existing research into the impacts of mathematics teaching and learning clearly show that the ways in which mathematics is taught in schools can have a considerable

impact on student attainment. A report into the mathematical needs of learners produced by the Advisory Committee on Mathematics Education (ACME) in the UK has shown that teaching strategies based on deepening and enriching students' mathematical understanding can have a positive impact on achievement. Conversely, when schools focus primarily upon results and disregard the mathematical understanding of the pupils, this can have a negative impact on the ability of young people to apply their mathematical knowledge in later life (ACME, 2011). There is also evidence to suggest that a more innovative and stimulating mathematics syllabus may have a disproportionately positive effect on lower achieving students, thus helping to close the gap in achievement and enthuse mathematics students of all abilities – not simply the higher achieving groups (JMC, 2011).

Whilst research has shown that many different approaches to mathematics can be effective according to the varying needs of learners, the 'use of higher order questions, encouraging reasoning rather than 'answer getting', and developing mathematical language through communicative activities' (Swan *et al.*, 2008:4) have been found to be particularly effective in developing students' conceptual understanding; investigation and problem-solving strategies; and fluency and appreciation of mathematics. Likewise, engaging students in mathematical discussion; encouraging them to make connections between different areas of mathematics; and encouraging them to participate in open-ended, investigative mathematics activities are particularly conducive to mathematical success (Hiebert and Grouws, 2009).

There remain, however, some areas promoted in the national policies of many countries, which remain underdeveloped in the teaching of mathematics. Data from the Trends in International Mathematics and Science Studies (TIMSS) has shown, for example, that students work in small groups less frequently than they work individually. This is challenging for the development of mathematics teaching and learning, given the importance of group work as a forum for discussion and collaboration. Similarly, whilst information and communication technology (ICT) is heavily prescribed in many jurisdictions, the use of computers in mathematics lessons is relatively rare (Eurydice, 2011). In the UK, research from the Joint Mathematical Council shows that despite heavy investment in digital materials for schools, the use of technology as a teaching resource for mathematics is greatly under-exploited, with teachers tending to use ICT as a visual aid rather than as an instrument to assist with mathematical thinking and reasoning (JMC, 2011).

Within this context, Project Maths occupies an important position within the Irish government's commitment to the central role of mathematics education as a necessary precursor to innovation, competitiveness and economic growth. In its plan for a 'smart economy', the Irish government identified the need to improve the mathematical skills of post-primary school leavers as a step towards realising the vision of Ireland as a hub of innovation (Department of the Taoiseach, 2008). This was echoed by the Innovation Taskforce (2010), who considered improvement in

mathematics attainment to be a necessary force for driving the science, technology and engineering disciplines at third and fourth levels. Furthermore, the Taskforce identified mathematics as 'crucial' to developing creativity and problem-solving skills, which are prerequisites for an innovative workforce.

1.2 Aims and objectives of the new mathematics syllabus

Whilst the specific objectives of the revised mathematics syllabuses are multifaceted, reflecting the wide range of learning that takes place within each age group and ability range, their core aims are to equip students at both Junior Certificate and Leaving Certificate levels with:

- the mathematical knowledge, skills and understanding they need to succeed in education, work and daily life
- the skills to use mathematics in context, and to solve problems with a range of real-life applications
- a lifelong enthusiasm for mathematics.

To achieve this, the revised mathematics syllabuses at Junior Certificate level aim to build upon students' experiences of learning mathematics at primary school. Among the objectives in the syllabuses are that learners develop an in-depth knowledge of, and enthusiasm for, the reasons and processes underpinning mathematics, as well as the ability to recall mathematical facts and techniques. It is envisaged that by fostering students' sense of creativity, they will be confident and able to apply their mathematical knowledge in a range of contexts.

The revised mathematics syllabuses at Leaving Certificate level seek to develop these skills further, encouraging students to engage with the connections between mathematics and other subjects, and to think creatively and effectively about the many ways that mathematics can be used and applied. In addition to the core mathematical knowledge necessary to succeed at this level, the revised syllabuses aim to meet many of the wider outcomes associated with Leaving Certificate studies, including, for example, communication skills and working with others.

1.3 Structure of the revised mathematics syllabus

The structure of the revised mathematics syllabus is underpinned by two key features. Firstly, development of the syllabus in all post-primary schools has built directly upon the experiences of the 24 phase one schools, using the insights from the experiences of those schools to inform and refine the initiative on an ongoing basis. Secondly, the new programme has been designed to allow schools a phased introduction of syllabuses in both junior cycle and senior cycle simultaneously, gradually building up the number of strands of the new syllabus taught each year. Each phase is accompanied by associated incremental changes in assessment and professional development.

Both the Junior Certificate and Leaving Certificate syllabuses are divided into five strands, as follows:

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

Across all of these strands, students are encouraged to test out and apply their knowledge to meaningful real-life contexts, and to take responsibility for their own learning through, for example, setting goals and developing action plans. Centred around the individual learner, the revised syllabuses are designed to offer a continuous learning experience for students throughout junior and senior cycles, building upon the foundations of mathematical knowledge acquired at primary school.

The timetable for introduction of the revised syllabuses in both phase one and non-phase one schools is detailed in Tables 1.1 and 1.2.

Table 1.1: Introduction of revised mathematics syllabus strands in junior cycle

	Cohort	Years of study	Syllabus strands
Initial 24 schools (phase one)	**1**	**2008 - 2011**	Strand 1: Statistics and Probability Strand 2: Geometry and Trigonometry
	2	**2009 - 2012**	Strand 1: Statistics and Probability Strand 2: Geometry and Trigonometry Strand 3: Number Strand 4: Algebra
	3	**2010 - 2013**	Strand 1: Statistics and Probability Strand 2: Geometry and Trigonometry Strand 3: Number Strand 4: Algebra Strand 5: Functions
All schools (non-phase one)	**1**	**2010 - 2013**	Strand 1: Statistics and Probability Strand 2: Geometry and Trigonometry
	2	**2011 - 2014**	Strand 1: Statistics and Probability Strand 2: Geometry and Trigonometry Strand 3: Number Strand 4: Algebra
	3	**2012 - 2015**	Strand 1: Statistics and Probability Strand 2: Geometry and Trigonometry Strand 3: Number Strand 4: Algebra Strand 5: Functions

Table 1.2: Introduction of revised mathematics syllabus strands in senior cycle

	Cohort	Years of study	Syllabus strands
Initial 24 schools (phase one)	1	**2008 - 2010**	Strand 1: Statistics and Probability Strand 2: Geometry and Trigonometry
	2	**2009 - 2011**	Strand 1: Statistics and Probability Strand 2: Geometry and Trigonometry Strand 3: Number Strand 4: Algebra
	3	**2010 - 2012**	Strand 1: Statistics and Probability Strand 2: Geometry and Trigonometry Strand 3: Number Strand 4: Algebra Strand 5: Functions
All schools (non-phase one)	1	**2010 - 2012**	Strand 1: Statistics and Probability Strand 2: Geometry and Trigonometry
	2	**2011 - 2013**	Strand 1: Statistics and Probability Strand 2: Geometry and Trigonometry Strand 3: Number Strand 4: Algebra
	3	**2012 - 2014**	Strand 1: Statistics and Probability Strand 2: Geometry and Trigonometry Strand 3: Number Strand 4: Algebra Strand 5: Functions

2. About the evaluation

This chapter sets out the overall approach to the evaluation of the impact of Project Maths on student achievement, learning and motivation including:

- the overarching aims of the evaluation, and key research questions
- the methodology for the evaluation, and details of the specific research activities presented in this report.

2.1 Aims of the research

The overarching aim of the research is to explore the impact of Project Maths on students' achievement, learning and motivation in mathematics, in both phase one and non-phase one schools. Table 2.1 sets out the key research themes for this study, mapped against each element of the research (outlined in more detail in section 2.2).

Table 2.1: Key research themes

Research theme	Assessment of student performance	Student attitude surveys	Analysis of students' work	Case studies
Students' achievement in mathematics, across each individual strand of the revised mathematics syllabuses	✓			
Comparison of students' performance in mathematics with international standards	✓			
Students' motivations and attitudes to mathematics, in general and in relation to the revised mathematics syllabuses		✓		✓
Students' opinions on the effectiveness of different strands and approaches used in the revised mathematics syllabuses		✓		✓
Students' perceptions of their knowledge, understanding, confidence and achievement in mathematics		✓		✓
Students' aspirations to further study of mathematics		✓		✓
Students' views of the relevance and application of mathematics more generally		✓		✓
Students' understanding of the processes being promoted in the revised mathematics syllabuses			✓	✓
The impact of the revised mathematics syllabuses on individual students' progress and standards			✓	
Trends in students' approaches to, and performance in, the revised mathematics syllabuses	✓		✓	
Challenges associated with teaching and learning of the revised mathematics syllabuses				✓
Facilitating factors associated with teaching and learning of the revised mathematics syllabuses				✓

2.2 Methodology

The methodology for this research comprises four main phases:

- **internationally comparable assessment of student achievement** in all strands of the revised mathematics syllabuses, based on indicator items administered to two separate cohorts of Junior Certificate and Leaving Certificate students in Spring 2012 and Autumn 2012 (focusing on the examination classes of 2012 and 2013, respectively)
- **attitude surveys exploring students' experiences** of the revised mathematics syllabuses and their confidence and motivation in mathematics, administered to two separate cohorts of Junior Certificate and Leaving Certificate students in Spring 2012 and Autumn 2012 (focusing on the examination classes of 2012 and 2013, respectively)
- **ongoing, data-rich case studies** in eight phase one schools, and eight non-phase one schools, exploring in depth students' and teachers' experiences of the revised mathematics syllabuses
- **qualitative analysis of students' work** exploring trends in the processes being promoted in the revised mathematics syllabuses and its impact upon individual students' progress, which will be gathered from the case-study schools in Autumn 2012 focusing on the Junior Certificate and Leaving Certificate examination classes of 2013.

This report presents the key findings arising from the first two elements of this research, drawing on the findings of the first assessment of student achievement and survey of student attitudes, motivation and confidence, administered to Junior Certificate and Leaving Certificate students in Spring 2012.

2.2.1 About the sample

This part of the research involved students at both Junior Certificate and Leaving Certificate level, who were in the examination year of 2012. They were, therefore, reaching the end of their mathematics syllabus at the time of participating in the research. The target number of students for this study is outlined in Table 2.2:

Table 2.2: Target number of students and schools

Phase one	JC	**Class of 2012** 500-700 students included in collection of attitudes and achievement data from all 24 phase one schools
	LC	**Class of 2012** 500-700 students included in collection of attitudes and achievement data from all 24 phase one schools
Non-phase one	JC	**Class of 2012** 2,000-3,000 students included in collection of attitudes data from a sample of 100 schools, of which 700-1,000 included in collection of achievement data (from 36 of the sampled schools)
	LC	**Class of 2012** 2,000-3,000 students included in collection of attitudes data from a sample of 100 schools, of which 700-1,000 included in collection of achievement data (from 36 of the sampled schools)

To achieve this sample, an initial population of 301 non-phase one schools was drawn, to arrive at a representative sample stratified by:

- school type
- school size
- schools included in the Delivering Equality of Opportunity in Schools (DEIS) programme, which aims to address educational disadvantage
- gender of students.

The sample was also drawn to be representative of geographical location: all 26 counties in the Republic of Ireland were included. Students were selected so that, across the sample, the distribution of predicted examination levels was broadly based on previous State Examination Commission (SEC) entry patterns. Table 2.3 provides a breakdown of the number of schools and students who participated in the research, by phase and level of study.

Table 2.3: Details of schools and students participating in the research

Phase one	JC	**Class of 2012** 375 students included in collection of attitudes data, and 303 included in the collection of achievement data from 19 of the phase one schools
	LC	**Class of 2012** 299 students included in collection of attitudes data, and 370 included in the collection of achievement data from 19 of the phase one schools
Non-phase one	JC	**Class of 2012** 2,375 students included in collection of attitudes data from 125 schools, of which 910 included in collection of achievement data (from 52 of the sampled schools)
	LC	**Class of 2012** 2,004 students included in collection of attitudes data from a sample of 125 schools, of which 722 included in collection of achievement data (from 52 of the sampled schools)

Table 2.3 shows that a total of 674 students in 19 out of 24 phase one schools (375 at Junior Certificate, and 299 at Leaving Certificate) took part in the attitude survey, and 673 in the assessment of student performance (303 at Junior Certificate and 370 at Leaving Certificate). Five of the phase one schools were unable to take part in this phase of the research due to other teaching and learning commitments (for example, timetabling issues, and participation in PISA 2012). However, these schools will be invited to participate in subsequent phases of this research. A total of 4,379 students in 124 non-phase one schools (2,375 at Junior Certificate, and 2,004 at Leaving Certificate), participated in the survey, and 1,632 students in 52 schools (910 at Junior Certificate, and 722 at Leaving Certificate) participated in the assessment of student performance. Overall, this represents approximately 82 per cent of the target response rate of students. Responses were drawn from a greater number of non-phase one schools than initially anticipated as the number of returns from individual schools was, in general, lower than expected.

The use of comparative data, to measure the impact of the revised mathematics syllabuses relative to the previous ones, is central to the research design. However, as this research commenced in January 2012, the revised syllabuses have been rolled out nationally to most cohorts of students (see Tables 1.1 and 1.2). Therefore, involvement of non-phase one Junior Certificate students in the examination class of 2012 represents the only comparison group included in this research. In place of a comparison group, it is intended that examinations data from previous years will be used later in the study to contextualise the findings from this research.

In Autumn 2012, a further round of attitude surveys and assessments of student performance will be conducted with Junior Certificate and Leaving Certificate students in the examination classes of 2013. This will enable comparisons to be drawn between year groups as the revised syllabus becomes further embedded and developed in schools.

2.2.2 Assessment of student performance

As detailed in Table 2.1, assessment of student achievement aims to gather quantitative data, focusing on:

- students' achievement in mathematics, across each individual strand of the revised mathematics syllabuses
- comparison of students' performance in mathematics with international standards
- trends in students' approaches to, and performance in, the revised mathematics syllabuses

Assessment of student performance at Junior Certificate level

In order to assess Junior Certificate students' performance in each individual strand of the revised mathematics syllabus, two item indicator booklets were created, each containing two syllabus strands. Table 2.4 shows the syllabus strands covered by each booklet, and the number of items in each booklet.

Table 2.4: Item indicator booklets for the Junior Certificate

Item indicator booklet	Syllabus strand	Syllabus area	Number of items	Number of pupils completing booklet
JC1/2	Statistics and Probability	• concepts of probability • outcomes of random processes • statistical reasoning with an aim to becoming a statistically aware consumer • representing data graphically and numerically • analysing, interpreting and drawing conclusions from data	11	1094
	Geometry and Trigonometry	• synthetic geometry • transformation geometry • co-ordinate geometry • trigonometry	10	
JC3/4	Number	• number systems • indices • applied arithmetic • applied measure	11	186
	Algebra	• representing situations with tables, diagrams and graphs • finding formulae • examining algebraic relationships • relations without formulae • expressions • equations and inequalities	10	

The booklets were made up of items from two international surveys: 'released' items[1] from TIMSS 2007 (Trends in International Mathematics and Science Study, a survey

[1] Released items are those that have been made public following administration of the survey, in contrast to secure items, which are kept secure for use in evaluating trends in performance in later cycles of TIMSS

of 13-14 year olds) and sample items[2] from PISA 2000, 2003 and 2006 (Programme for International Student Assessment, a survey of 15 year olds). Further explanation of the suitability of the international surveys for this research is detailed below. The use of the TIMSS items has allowed a direct comparison to be made between international results and the results of the phase one (and comparison group) students. Appendix A, Table 1 shows the origin of each item in the five item indicator booklets.

It should be noted that the number of students, at both Junior Certificate and Leaving Certificate, completing each of the item indicator booklets varies. Facilities based on relatively small numbers of pupils taking each item are not estimated to a high level of precision so should be treated with a degree of caution. To estimate facility with a reasonable degree of precision we would usually need to sample around 400 pupils in each group to be reported.

Assessment of student performance at Leaving Certificate level

In the Leaving Certificate examination, students are assessed in five revised mathematics syllabus strands. One item indicator booklet was created for each of these strands. Table 2.5 shows the syllabus strands covered by each booklet, and the number of items in each booklet.

Table 2.5: Item indicator booklets for the Leaving Certificate

Item indicator booklet	Syllabus strand	Syllabus area	Number of items	Number of pupils completing booklet
SPLC1	Statistics and Probability	• concepts of probability • outcomes of random processes • statistical reasoning with an aim to becoming a statistically aware consumer • representing data graphically and numerically	9	902
GTLC2	Geometry and Trigonometry	• synthetic geometry • co-ordinate geometry • trigonometry	10	899
NLC3	Number	• number systems • length, area and volume • problem solving and synthesis skills	10	185

[2] Sample items exemplify the type of material included in a PISA assessment, but have not been used in a live test and so have no data available.

ALC4	Algebra	• expressions • solving equations • inequalities • complex numbers	7	186
FLC5	Functions	• functions • calculus	9	180

The booklets were made up of items from three international surveys: released items[3] from the Trends in International Mathematics and Science Study (TIMSS - 2007, 8th grade and TIMSS Advanced, 2008), and sample items[4] from the Programme for International Student Assessment (PISA) surveys of 2000, 2003, and 2006. Leaving Certificate items were specifically selected to match the revised mathematics syllabus and to assess a variety of mathematical skills. These items were also designed for use with students in their final year of secondary school, which matches the stage of schooling of the Leaving Certificate sample in this evaluation. However, some items were also drawn from the same sources as the Junior Certificate items. This was done for three main reasons. First, these items matched the revised syllabus for the Leaving Certificate. Second, the use of common items across both Junior and Leaving Certificate allowed for some comparison to be made across years. Finally, in PISA there is a focus on context and real-world applications of mathematics, which is a key element of the Project Maths initiative. Their use has allowed a direct comparison to be made between international results and the results of the phase one (and non-phase one) students. Appendix A, Table 2 shows the origin of each item in the five item indicator booklets.

Suitability of TIMSS and PISA studies for this research

TIMSS and PISA are international comparison studies (four-yearly and three-yearly respectively), evaluating students' achievement in, and attitudes towards, mathematics and science (PISA also assesses reading). While the students who participate in PISA are of a similar age to those participating in the Junior Certificate, they are younger than those taking the Leaving Certificate examinations. The TIMSS students are younger than both groups: those taking the Leaving Certificate and those taking the Junior Certificate. These studies might, therefore, seem to be inappropriate choices as comparative studies for this evaluation. However, they are the only two major international comparison studies which evaluate students' achievement in, and attitudes towards, mathematics and were, therefore, selected as the most relevant international comparison studies for this purpose. It is important to bear in mind that the TIMSS items are designed for a wide range of students, with

[3] Released items are those that have been made public following administration of the survey, in contrast to secure items, which are kept secure for use in evaluating trends in performance in later cycles of TIMSS.
[4] Sample items exemplify the type of material included in a PISA assessment, but have not been used in a live test and so have no data available.

some designed to challenge more able students and others to be more widely accessible. This range made them relevant for this evaluation, despite the age differences outlined above. Differences in age and stage of schooling are taken into account in this report in the discussion of students' performance on the item indicator booklets.

The international studies give some initial indicators of how the achievement of Ireland's students in the revised syllabus strands compares with achievement internationally on assessment items related to those strands. In addition and more importantly, the data gathered from the first administration of these 'indicator' items will provide a baseline against which the achievement of Irish students' can be benchmarked internationally in future. As a first step towards measuring change over time, the TIMSS assessment items answered by the evaluation sample in Spring 2012 will be administered to a further sample of students in Autumn 2012, and this will allow comparison of results over that period, as the revised syllabus begins to become more established in schools.

Because the TIMSS items were selected to match the revised mathematics syllabus, they are drawn from across different TIMSS assessment booklets. As a result, the items provide an indication of how the performance of students following the revised syllabus on those items compares with that of students internationally, but they do not allow conclusions to be drawn about students' performance on a syllabus domain as a whole. This would require a test of representative syllabus coverage that had been trialled and analysed for whole-test reliability, rather than a collection of separate but connected items. It is important to bear this in mind when interpreting the outcomes from the item indicator booklets.

Administration and marking of the assessment booklets

The item indicator booklets were administered to students by their teachers, in the 19 phase one schools and in 52 comparison group schools. Booklets were returned to NFER before being marked using the NFER's own on-line system. Multiple-choice items were double marked by the NFER's data capture staff. The remainder of the items were marked by the NFER team. Teachers in the participating schools were not involved in marking the item indicator booklets.

Versions of the revised mathematics syllabus referenced in this report

Several interim mathematics syllabuses have been created as the Project Maths initiative has been developed. All references to the syllabus in this report have been taken from the Junior Certificate Mathematics syllabus for examination in June 2015 and the Leaving Certificate Mathematics syllabus for examination in 2014 only. It was felt that consistency in the labelling of the sub-sections of each strand would make comparisons easier both between the Junior Certificate and the Leaving Certificate stages of school and between the different phases of assessment that are being carried out for this research. Use of the latest syllabus provides this consistency. Where a sub-section of a strand is referred to, the relevant numbering from the

syllabus is provided in brackets. For example, 'representing data graphically and numerically' is labelled as sub-section 1.6 of Strand 1, Statistics and Probability.

A technical note about the international data

As previously mentioned, international data is only available for those items which were sourced from either TIMSS 2007 or TIMSS Advanced 2008. To compare the performance of the Irish students to international standards, TIMSS international item level data was downloaded from the TIMSS international database. This included the TIMSS year 8 dataset and the TIMSS Advanced year 12 database from 2008. There were 48 countries involved in TIMSS 2007, and 20 countries were involved in TIMSS Advanced 2008. This means the number of pupils taking each item varied across items. In order to compare common items with the international outcomes, facilities[5] were calculated by weighting item raw scores by total student weight (TOTWGT). This provides a more robust international estimate for item facility and allows comparison to the revised syllabus item results.

2.2.3 Student attitude surveys

As detailed in Table 2.1, the student attitude survey aims to gather quantitative data, focusing on:

- students' motivations and attitudes to mathematics, in general and in relation to the revised mathematics syllabus
- students' opinions on the revised mathematics syllabus, including the effectiveness of different strands and approaches
- students' perceptions of their knowledge, understanding, confidence and achievement in mathematics
- students' aspirations to further study of mathematics
- students' views of the relevance and application of mathematics more generally.

Surveys were administered to students by their teachers, and contained questions relating to students' experiences of, and attitudes towards, mathematics in general, as well as questions relating to individual strands of the revised syllabus. As both groups of Leaving Certificate students, and phase one Junior Certificate students were studying between two and five strands of the revised mathematics syllabus, strand-specific questions were asked of all students, in order to determine the impact of the revised syllabus on motivation, attitudes and confidence.

[5] Facility' is a measure of the difficulty of an item, expressed as the percentage gaining credit for their answer.

Part A

Achievement, learning and motivation of Junior Certificate students

3. About the Junior Certificate students

This chapter describes the profile of the Junior Certificate students who participated in this research, as a basis for further exploration in subsequent chapters. The findings from the assessment of student achievement are presented in Chapter 4, and from the survey of student attitudes in Chapter 5.

3.1 About the students

In total, 375 students from 19 phase one schools, and 2,375 students from 125 comparison group schools, completed the Junior Certificate student attitude survey. A total of 303 students from the same phase one schools, and 910 students from 52 of the comparison group schools, completed the Junior Certificate assessment of student performance.

3.2 Syllabus strands studied

The Junior Certificate students who participated in the research were in the examination class of 2012: they were, therefore, in their final year of their Junior Certificate studies. Having commenced junior cycle in September 2009, participating students in the phase one schools were in the second cohort of those following the revised mathematics syllabus. These students had studied the following four strands of the revised syllabus:

- Strand 1: Statistics and Probability
- Strand 2: Geometry and Trigonometry
- Strand 3: Number
- Strand 4: Algebra.

The comparison group[6] was composed of Junior Certificate students in non-phase one schools, also in their examination year. This cohort of students was following the previous mathematics syllabus introduced in 2000, and had not studied any strands of the revised syllabus.

[6] The revised syllabus was introduced to non-phase one schools in September 2010. As this group of students commenced junior cycle in September 2009, they did not follow the revised mathematics syllabus.

4. Achievement of Junior Certificate students

This chapter presents the findings of the assessment of Junior Certificate student achievement in phase one schools across all four strands of the revised mathematics syllabus studied. These findings are compared to the achievement of comparison group students, and to international standards. Key messages are highlighted in each of these sections.

4.1 Overview of achievement patterns

The performance of the phase one students on the Junior Certificate item indicator booklets showed some clear patterns, which are described in detail in section 4.2. For example, it can be noted that **items requiring higher order skills (such as reasoning and an ability to transfer knowledge to new contexts) are found more difficult than those which are more mechanical in demand**. Comparison group students (those in non-phase one schools) also showed this same pattern. The performance of phase one and comparison group students is similar with no statistically significant difference on any item. Therefore, it would appear that there is **no discernible difference in the students' skills** as measured by the items contained in the item indicator booklets.

The pattern of performance when compared with the international data centres on the different topic areas of the syllabus, rather than on overarching skills that can be applied more generally. These comparisons are affected by differences in the sample between TIMSS and this study, with the TIMSS students being somewhat younger. Whilst **phase one students scored well on the majority of items, it seems that they find Algebra (Strand 4) and 'Examining algebraic relationships' in particular to be especially difficult.** Facilities[7] for items assessing this area of the syllabus are low, and in some cases, below the international average. This is noteworthy since we would expect phase one students to perform above the available international averages on these items (due to the differences in the samples, as discussed in section 4.2). By contrast, phase one **students have shown a strong performance on items assessing Statistics and Probability (Strand 1)**. Although phase one students perform above the international average in Geometry and Trigonometry (Strand 2) and Number (Strand 3) this is to be expected given the sampling differences.

[7] 'Facility' is a measure of the difficulty of an item, expressed as the percentage gaining credit for their answer.

4.2 Performance in detail: phase one schools

Key messages

In relation to Strand 1 (Statistics and Probability) and Strand 2 (Geometry and Trigonometry) of the revised syllabus, there were no items which students appeared to have found particularly difficult. Students also performed well on the majority of items relating to Strand 3 (Number) and Strand 4 (Algebra), although there were some specific items that students appeared to find more challenging. However, students showed a wide variation of abilities within each area of the syllabus, suggesting that **phase one students struggled with particularly demanding questions, rather than a specific topic or theme.**

The performance of the phase one students on the Junior Certificate item indicator booklets suggest that, in general, **items requiring higher order skills** (such as reasoning and an ability to transfer knowledge to new contexts) are found more difficult than those which are more mechanical in demand.

4.2.1 Strand 1 (Statistics and Probability) and Strand 2 (Geometry and Trigonometry)

A total of 184 students from phase one schools completed item indicator booklet JC1/2 (for further details on the methods used, see chapter 2). This booklet contained items assessing statistics, probability, trigonometry and geometry (Strands 1 and 2). Column four of Table 4.1 below shows the performance of phase one students completing JC1/2[8]. For two mark items, the table shows the proportion of students who achieved just one mark, and the proportion who received full credit. For each item, the table also gives the broad syllabus area assessed and a summary of the task (see Appendix A, Table 3 for performance on each item matched to the specific numbered area of the revised syllabus, as referred to in the following commentary).

[8] The table also shows the performance of non-phase one students.

Table 4.1: Item indicator booklet JC 1/2 – Student performance and summary of items

Item	Syllabus area	Item summary	Phase one students		Non-phase one students	
			1 mark (%)	2 marks (%)	1 mark (%)	2 marks (%)
1	Probability	Estimate and compare probabilities (numbered tickets)	87		87	
2	Interpreting data	Interpret data (bar chart)	96		95	
3	Representing data	Transform data (pie chart to bar chart)	6	62	8	60
4	Probability	Estimate probability (coloured marbles)	86		76	
5	Representing data	Match tabulated data to corresponding line graph	95		94	
6a	Interpreting data	Use bus timetables to plan travel according to time constraints	17	47	21	40
6b	Interpreting data	Use bus timetables to plan travel according to time constraints	24	33	27	28
6c	Interpreting data	Draw conclusions from tabulated data	47		47	
7a	Representing data	Find and compare means from tabulated data	73		74	
7b	Interpreting data	Draw conclusions from data in scatter graph	35	41	37	37
8	Probability	Find number of coloured beads (from probability of selection)	71		70	
9	Statistical reasoning	Understand how data points relate to their average	22		19	
10	Probability	Estimate size of sectors on coloured spinner (from experimental data)	60		52	
11	Statistical reasoning	Recognise that a graph is potentially misleading	37	17	32	13
12	Coordinate geometry	Identify a point given coordinates	87		82	
13	Synthetic geometry	Find size of angle (using congruent triangles & sum to 180)	59		52	
14	Synthetic geometry	Find size of angle formed by diagonals of hexagon	67		59	
15	Synthetic geometry	Find size of angle (using straight angle)	64		68	
16	Synthetic geometry	Find size of angle (using vertically opposite angles & isosceles triangle)	37		40	
17	Transformation geometry	Rotate 3-D shape	76		81	
18	Coordinate geometry	Identify coordinates of top vertex of isosceles triangle	73		65	
19	Synthetic geometry	Construct obtuse & acute angles	51		46	
20	Synthetic geometry	Find size of angle (using bisectors & straight angle)	35		41	
21	Synthetic geometry	Find size of angles (using alternate angles or exterior angle)	65		56	

Table 4.1 shows that the range of facilities for JC 1/2 is from 22 per cent to 96 per cent with students performing well on the majority of items. There are no items which students have found exceptionally difficult (facility <20 per cent) but both item 2 and item 5 were very easy with facilities higher than 90 per cent (96 per cent and 95 per cent respectively).

Item 2 assesses 'Analysing, interpreting and drawing conclusions from data' (1.7). It requires students to read and manipulate data depicted on a bar graph. The same area of the syllabus is assessed by items 6a, 6b, 6c and 7b although these are based on timetables and a scatter graph rather than a bar chart. The facilities for these items are in the range of 45-58 per cent so it is likely that the simplicity of the bar chart in item 2 is the cause for the high facility rather than a particular proficiency in this syllabus area.

Item 5 assesses 'Representing data graphically and numerically' (1.6). Students are asked to select (from four options) the graph which shows the information given in a table. The same area of the syllabus is assessed by items 3 and 7a. The lower facilities of these items (1m: 6 per cent, 2m: 62 per cent[9] for item 3 and 73 per cent for item 7a) are likely to be due to the greater demand necessitated by the need to manipulate the data. By comparison item 5 more simply requires transposing the data to a different form.

4.2.2 Strand 3 (Number) and Strand 4 (Algebra)

Item indicator booklet JC3/4 was completed by 186 phase one students. It contains items assessing number and algebra. Table 4.2 shows the performance of phase one students completing JC3/4, as well as the broad syllabus area assessed and a summary of the task (see Appendix A, Table 3 for performance on each item matched to the specific numbered area of the revised syllabus).

[9] For items worth two marks, facilities are expressed as the percentage gaining exactly one mark and the percentage gaining full credit (two marks).

Table 4.2: Item indicator booklet JC 3/4 - Student performance and summary of items

Item	Syllabus area	Item summary	Phase one students[10]	
			1 mark (%)	2 marks (%)
1	Number: percentages	Estimate percentage of four digit number	77	
2	Scientific notation	Evaluate number written in scientific notation	90	
3	Number: ratio	Find number of boys in a class given boy:girl ratio	69	
4	Number: fractions	Add and subtract simple fractions	50	
5	Applied measure	Find distance travelled in given time	83	
6	Number: operations	Perform division with negative number	72	
7	Number: prime factors	Recognise prime factors of four digit number	59	
8	Applied measure	Compare value for money of two pizzas based on surface area	3	0
9	Applied measure	Interpret graph (speed of racing car on track)	93	
10a	Applied arithmetic	Currency conversion with given exchange rate	74	
10b	Applied arithmetic	Explain benefit of lower exchange rate	34	
11	Number: proportion	Understand proportional relationship (cost of apartment based on floor area)	10	
12	Representing situations	Use numerical methods to extend pattern of matches	12	17
13a	Representing situations	Complete table of number of trees by expanding systematic pattern	8	66
13b	Equations	Solve equation with quadratic term	29	
13c	Algebraic relationships	Understand that squared terms increase more quickly than linear terms	12	9
14	Graphical relations	Interpret graph of motion (moving walkway)	14	
15	Inequalities	Solve linear inequality	38	
16	Expressions	Simplify linear expression with two variables	73	
17	Finding formulae	Express unknown length in terms of two variables	65	
18	Expressions	Evaluate expression with two variables	54	
19	Equations	Solve linear equation (shipping charges)	57	
20	Algebraic relationships	Determine which point is on a line (given equation)	36	
21	Finding formulae	Derive formula for linear relation between two variables	46	

[10] Non-phase one students are not included in this table as they did not complete booklet JC 3/4.

Table 4.2 shows that the proportions of students scoring one or both marks range from 0 per cent to 93 per cent and students performed well on the majority of items. However, item 9 proved to be very easy for the students (facility, 93 per cent) and some items (8, 11, 12, 13c and 14) were particularly difficult (facilities <25 per cent).

Items 8 and 9 assess the same area of the syllabus (Applied measure, 3.4) yet have the lowest and highest facilities in the booklet (1m: 3 per cent, 2m: 0 per cent; and 93 per cent respectively). This indicates that the topic area itself is not the main factor in determining performance, but rather the demand of the item. Item 9 asks students to interpret a graph that shows the speed of a vehicle over time. It therefore also requires basic skills in 'Analysing, interpreting and drawing conclusions from data' (1.7), a skill students have already demonstrated in item 2 of JC1/2 that they are proficient in. Item 8 on the other hand requires students to calculate and compare the surface area of two pizzas. Very few students attempted to do this and instead incorrectly reasoned that the pizzas offered the same value for money (39 per cent).

Item 11 (facility, 10 per cent) assesses 'Number systems' (3.1) which is also the main focus of items 1, 3, 4, 6 and 7. The facilities of these latter items range from 50 to 77 per cent, again indicating that the difficulty of item 11 is due to the specific item demand rather than the topic area. The main difference between item 11 and the other comparable items is that students are not required to make a particular calculation. Rather, they must reason and make generalisations using their knowledge of proportions within the given topic of purchasing an apartment building. Item 12 (facility, 1m: 12 per cent, 2m: 17 per cent) assesses 'Representing situations with tables, diagrams and graphs' (4.2). However, for item 13a which assesses the same area, 66 per cent of students achieved full credit. It is likely that differing demands of the items are affecting performance. In addition to assessing 'Representing situations', item 12 also assesses students' reasoning and their ability to find a simple formula (4.3), which makes the item more challenging.

Item 13c (facility 1m:12 per cent, 2m:9 per cent) assesses elements of 'Examining algebraic relationships' (4.4) as does item 20 (facility 36 per cent). It is not surprising that item 13c has a lower facility than item 20 as it asks students to contrast a linear and quadratic relationship in order to explain whether the number of apple trees (quadratic) or the number of conifer trees (linear) will increase more quickly. Item 20 by contrast is a multiple choice item requiring numbers to be substituted into a simple algebraic equation. The generally low facilities in this area of the syllabus suggest that students may be finding it more difficult than other topic areas. Interestingly 'Examining algebraic relationships' also includes proportional relationships which was assessed in item 11 (facility, 10 per cent).

Item 14 is the final item that has a low facility (14 per cent). It assesses 'Relations without formulae' (4.5). It asks students to draw a line on a graph to show the distance travelled by a person standing still on a moving walk way in comparison to people walking on the walk way or on the ground. This area of the syllabus has not

been assessed by any other item in the indicator booklet. Therefore it is difficult to make generalisations regarding the cause of the low facility.

The majority of omission rates are below 15 per cent for items in both the JC1/2 and JC3/4 indicator item booklets. Items with omission rates greater than 15 per cent are all open response items. This is not unexpected as the multiple choice format allows students to make an informed guess at an answer even if the item is difficult. A difficult open response item, however, provides less structure for students who are not sure how to answer.

4.3 Comparison of student performance between phase one and comparison group schools

Key messages

The performance of phase one and comparison group students at Junior Certificate level is similar. Whilst, in general, phase one students performed better than their comparison group peers, this difference is only statistically significant in relation to a particular item exploring students' abilities in Strand 1, Statistics and Probability (assessing students' understanding of the outcomes of simple random processes). It is therefore reasonable to conclude that **engagement with the revised syllabus has not yet influenced the performance of phase one students** at Junior Certificate level relative to their peers following the previous syllabus.

Table 4.1 also presents the scores of students from comparison group schools who completed JC1/2 (N=910). This allows for a basic comparison of performance between phase one and non-phase one students. Appendix A, Table 3 presents further analysis of this comparison, using the statistical method of differential item functioning analysis.

This table shows that, in some cases, the performance of students from comparison group schools follows a similar pattern to that of the phase one students. For example, items 2 and 5 were completed easily and item 9 proved more difficult. However, many items have facilities that are between five and ten percentage points different from those of the phase one students. Phase one students scored five to ten percentage points higher on eleven of the 29 items or item parts. These are highlighted in orange in Appendix A, Table 3. The difference in performance of all but one of these marks is likely to be due to sample differences (significance five per cent or higher). Only on item 4 do phase one students perform statistically better than their comparison group peers. Item 4 assesses students' understanding of 'Outcomes of simple random processes' (1.3). The students are asked to identify the true statement regarding the probability of which colour marble will be picked out of a bag next. This item has the largest difference in facility (10 percentage points) between the two groups of students. The omission rate for both groups of students is the same (1 per cent). As a result, the options that the students chose were studied to identify

any difference in the pattern of responses. The first option is the correct one and as noted above was chosen less often by students in the comparison group schools. However, the pattern of selection of the other options is similar to that for the phase one students, as presented in Table 4.3 below.

Table 4.3: Answers given for item 4 by phase one and comparison group students

Answer option	Phase one students choosing each answer option (%)	Comparison group students choosing each answer option (%)
A	86	76
B	1	5
C	10	13
D	2	5
Omitted	1	1
Total	100	100

Table 3 (Appendix A) shows that comparison group students performed better than their peers by five or more percentage points on two items. The difference in facilities is significant beyond the five per cent level for item 20. This item assesses 'Synthetic geometry' (2.1) which is also the focus for items 13, 14, 15, 16, 19 and 21. It is unclear why comparison group students have performed better on item 20 as it is similar in demand to several of the other items in that it asks students to calculate the size of an angle.

While phase one students have scored higher on more items than the comparison group students, the difference in performance for each item is not statistically different. On the basis of this analysis, it seems reasonable to conclude that engagement in the revised syllabus has not influenced the performance of the students in the phase one schools at Junior Certificate level.

4.4 Comparison of student performance with international standards

Key messages

In general, phase one students scored well on the majority of items in comparison to international standards. In particular, phase one students have shown a **strong performance on items assessing Statistics and Probability (Strand 1)**.

However, phase one students appear to find **Algebra (Strand 4) and 'Examining algebraic relationships' in particular to be especially difficult**. Overall, their knowledge on subject areas relating to Strands 2 and 3 appear to be similar to that internationally.

The Junior Certificate item indicator booklets were constructed using material from two international surveys: 'released' items[11] from TIMSS 2007 (Trends in International Mathematics and Science Study, a survey of 13-14 year olds) and sample items[12] from PISA 2000, 2003 and 2006 (Programme for International Student Assessment, a survey of 15 year olds). For the majority of the TIMSS items, the international average facility is available. However, no international data could be sourced for item 9 of JC1/2. This item was not included in the analysis of TIMSS 2007 data, and therefore is not included in the available dataset. Comparative international data for the PISA items is also not available as these are sample items, which were not used in a live test. As the performance of the phase one and comparison group students is similar and the comparison group students did not complete item indicator booklet JC3/4, international data is only compared with that of the phase one students.

There are three factors that should be highlighted and considered when comparing the performance of the phase one students with that internationally. Firstly, and most importantly, as outlined earlier, there is a substantial difference in the average age of the two groups of students. The TIMSS items were originally used to collect data about the performance of students in the 8th grade. These students would be 13 to 14 years old. The students completing the Junior Certificate, however, are mostly 14 or 15 years old. They are one school year older than the students who completed the TIMSS assessments. It is not possible to quantify the effect that this difference in age and additional schooling has had. However, it is plausible that there would be some effect and it should be anticipated that the Irish students would, therefore, achieve higher scores.

A second factor to consider when comparing the performance is the stage of the students' schooling. Students who completed the Junior Certificate item indicator booklets were preparing for the live Junior Certificate examinations which would require considerable revision and preparation. While the situation would vary internationally, it is unlikely that the international students would have been preparing for or had just completed examinations of this kind. Both the amount of revision and the students' familiarity with the exam situation may have influenced the difference in performance. Although it is not possible to quantify, this suggests that the Irish students may be at an advantage in answering the TIMSS items.

Thirdly, the TIMSS international averages are derived from a range of countries. Some are highly developed and high-performing countries, while others are less well developed and less highly performing. As such, they provide a useful baseline measure of the achievement of the phase one students' performance on the TIMSS

[11] Released items are those that have been made public following administration of the survey, in contrast to secure items, which are kept secure for use in evaluating trends in performance in later cycles of TIMSS

[12] Sample items exemplify the type of material included in a PISA assessment, but have not been used in a live test and so have no data available.

items, but data should be interpreted with this context in mind. Appendix A, Table 4 repeats the average scores of the phase one students (given in Table 3) and compares them with the international average scores in the 2007 TIMSS study. As expected, phase one students appear to have generally scored more highly than the international average.

4.4.1 Strand 1 (Statistics and Probability) and Strand 2 (Geometry and Trigonometry)

Comparative data is available for 22 out of 24 items or item parts of JC1/2, and the average facility for each item is higher for the phase one students than the international students on all items and item parts. Table 4.4 shows the number of items with differences in facility that fall within the three performance bands as described above.

Table 4.4: Number of items in JC1/2 showing facility differences in each performance band

Difference in facility between phase one and international students (percentage points)	Number of items with a score difference of 0-9 percentage points	Number of items with a score difference of 10-24 percentage points	Number of items with a score difference of ≥25 percentage points	Total
Phase one students score more highly	3	9	10	22
International students score more highly	0	0	0	0

The differences in sample in terms of age, length of schooling and preparedness for exams have led us to expect the phase one students to achieve higher scores. Items which show little difference (0-9 percentage points) in performance (and where it is possible that the difference could be due to sampling effects) might indicate areas in which the Irish students are performing less well than anticipated. There are three such items (15, 16 and 20) which all assess 'synthetic geometry' (2.1). They are similar in demand to items 13, 14 and 21. All six of these items ask students to calculate the size of an angle. Interestingly, items 13, 14 and 21 have differences in facility of 16-26 percentage points, higher than items 15, 16 and 20. It is unclear why these six items should show such a large variation in comparative performance given that their construct is so similar.

Phase one students have performed much better (≥25 percentage points) than international students on many of the items in JC1/2. The majority of these, however, fall within syllabus Strand 1 (Statistics and Probability). Within this strand, the phase one students have consistently outperformed the international average by at least 20 percentage points.

There is some historical evidence of proficiency in this content area among Irish students compared with their peers internationally. In TIMSS 1995, Irish students scored an average of 69 per cent correct in items assessing 'Data representation, analysis and probability', while the international average was 62 per cent (IEA Third International Mathematics and Science Study, 1994-95).[13] However, the elevated performance of phase one students in the present evaluation may also reflect the increased emphasis on Statistics and Probability in the revised syllabus. While the old syllabus included elements of statistics and data analysis, the Project Maths initiative has made Statistics and Probability a key component of mathematics at both Junior and Leaving Certificate level. This strand covers basic skills such as calculating probabilities and measures of central tendency. However, there is also a focus on higher order skills, including an emphasis on 'Statistical reasoning with an aim to becoming a statistically aware consumer'. The high performance of phase one students on the items in this strand is encouraging and suggests that the implementation of this part of the new syllabus is working well.

4.4.2 Strand 3 (Number) and Strand 4 (Algebra)

Comparative data is available for 15 out of 24 items/item parts of JC3/4. As for JC1/2, the average facilities show that phase one students are generally performing better than the international students. Table 4.5 below shows the number of items with differences in facility that fall within the three performance bands.

Table 4.5: Number of items in JC3/4 showing facility differences in each performance band

Difference in facility between phase one and international students (percentage points)	Number of items with a score difference of 0-9 percentage points	Number of items with a score difference of 10-24 percentage points	Number of items with a score difference of ≥25 percentage points	Total
Phase one students score more highly	2	8	2	12
International students score more highly	1	1	1	3

The elevated performance of the phase one students is generally as expected given the differences in sample in terms of age, length of schooling and preparedness for exams. However, there are some exceptions where international students have scored more highly by more than 10 percentage points) or similarly (0-9 percentage points) to the phase one pupils. (Any differences in this latter group of items could possibly be due to sampling effects.) There are five such items in JC3/4 and these

[13] These results are for the Grade 8 students (in Ireland this corresponded to students in their second year of secondary school).

are likely to be items on which phase one students are not performing as well as might be expected. International students are performing considerably better than phase one students on items 15 and 20. Item 20 assesses an area of the syllabus (Examining algebraic relationships) that is not assessed by any other available internationally comparable item. It asks students to identify the graph point which lies on a line with a given equation. It does not particularly require the use of higher order skills such as problem solving and logical reasoning and may simply reflect a lack of confidence in this area of the syllabus as item 13c, which also assesses this area of the syllabus was also found difficult by phase one students (facility ≥1m: 21 2m: 9).

Item 15 assesses 'expressions' as do items 16, 18 and 19. Of these, items 15 and 16 ask students to identify an equivalent equation by simplifying the one given. Items 18 and 19 on the other hand require students to substitute a value into an equation. The pattern in the difference in performance is difficult to explain, as items 16 and 19 show little difference in performance while item 18 appears to favour phase one students. Item 18 requires two values to be substituted and there are brackets in the equation while for item 19, students must decide which of the values they are substituting for (and which they are calculating) and also there is some simplification required too.

Item 21 is the final item in JC3/4 on which phase one students do not substantially outperform the international sample (the difference is just two percentage points in favour of phase one students). It assesses 'Finding formulae' an area of the syllabus also assessed by item 17. These items differ slightly in that students can check their answer to item 21 by substituting values into the equation and checking that the answer matches the data given in a table. This is not possible for item 17 which also requires students to interpret a relationship described in the text. It is likely to require a greater depth of understanding than item 21 which enables students to use their data handling skills, an area in which they have already demonstrated they are proficient (in JC1/2).

Items assessing Strand 3 of the syllabus (Number) are generally showing performance as anticipated, with phase one students scoring higher than the international average. Item 4 was completed particularly well by phase one students It assesses 'Number systems' (3.1) an area of the syllabus that is assessed by several other items which can be compared with international data (1, 3, 6 and 7). The items are mostly similar in style with a description of a scenario and a calculation to be carried out in answer to the question. It is not clear why phase one students are performing particularly well on item 4, compared with the other items addressing this area.

It is clear from the evidence in Table 4 that phase one students are generally performing better in comparison with the international 2007 TIMSS sample. Twenty-nine (78 per cent) of the 37 Junior Certificate items for which international data is available show differences in facility of more than 10 percentage points in favour of phase one students. The corresponding proportion on which the international

students score higher is just five per cent (two items). Six items (16 per cent) show little difference in performance. Given the wide breadth of the revised mathematics syllabus it is difficult to cover all topic areas comprehensively enough to draw conclusions on the topic areas or skills that phase one students are most likely to excel at. However, it is likely that phase one students have more secure knowledge in statistics, but are perhaps less knowledgeable in algebra than the international average. They are of a similar average standard as the (younger) international students in geometry, trigonometry and number. Table 4.6 gives the average per cent correct in each Mathematics content area for the eighth grade Irish and international samples in the 1995 TIMSS survey.

Table 4.6: Average per cent correct in each mathematics content area

TIMSS 1995 Sample	Mathematics overall %	Fractions and number sense %	Geometry %	Algebra %	Data represent-ation analysis and probability %	Measurement %	Proportion-ality %
Ireland	59	65	51	53	69	53	51
Internat-ional average	55	58	56	52	62	51	45

The most recent TIMSS data for Ireland comes from the 1995 survey (TIMSS 2011 outcomes, including those for Ireland, will be published in December 2012) and it provides some historical context with which the performance of phase one schools can be compared. In the 1995 survey Irish students performed better than the international average in mathematics overall and in data representation, analysis and probability. The phase one students have also shown a strong performance in statistics. Previously Irish students did less well than the international average in Geometry. With the advantage of age and an extra year of schooling, phase one students have scored more highly in Geometry. Algebra has continued to be an area that Irish students find difficult. In 1995 Irish students showed a strong performance on Number items in comparison to the international average. Phase one students are also performing higher than the international average, but this is with the advantages mentioned previously.

5. Junior Certificate student attitude survey

This section presents the findings of the first survey of Junior Certificate students' attitudes towards mathematics, for both phase one and comparison group schools. It explores:

- their experiences of mathematics lessons
- their attitudes towards learning mathematics
- their views and perspectives on careers involving mathematics.

Key messages are highlighted in each of these sections, and in relation to individual strands of the revised syllabus.

5.1 Students' experiences of mathematics lessons

To contextualise students' attitudes towards mathematics, and to compare the learning experiences of phase one students with the comparison group, participants were asked about how mathematics is taught in school. Students were asked about the frequency with which they participated in a range of activities which feature in the revised mathematics syllabus. This included how often they:

- **apply their learning in mathematics**, including how often they apply what they learn in mathematics to real-life situations, and make links between different mathematics topics
- **consider the processes underpinning mathematics** (the 'how' and the 'why' of mathematics), including how often they think about mathematics problems and plan how to solve them, and show their working to justify their answers
- **participate in discursive, collaborative activities**, including how often they work together in groups or pairs, and talk about their ideas using the language of mathematics
- **participate in investigative, practical activities**, including how often they plan and conduct investigations to solve mathematics problems, and use IT in mathematics lessons
- **actively engage in their own learning and progress**, including how often they set goals and targets about their mathematics learning.

Students were also asked about the frequency with which they participate in activities which are **not** intended to feature in the revised syllabus, instead representing more traditional approaches to mathematics teaching and learning (for example, learning by rote and teaching for success in particular types of examination question). This included how often students:

- use textbooks in lessons then later practise what they have learned
- practise examination questions in class
- copy what their teacher writes on the board then practice using examples.

An overview of Junior Certificate students' perspectives in relation to each of these areas is presented in Figure 5.1. Phase one students are presented alongside those of the comparison group so that similarities and differences are immediately apparent.

Figure 5.1: Proportion of Junior Certificate students reporting that they 'often' or 'sometimes' take part in the specified mathematics teaching and learning activities

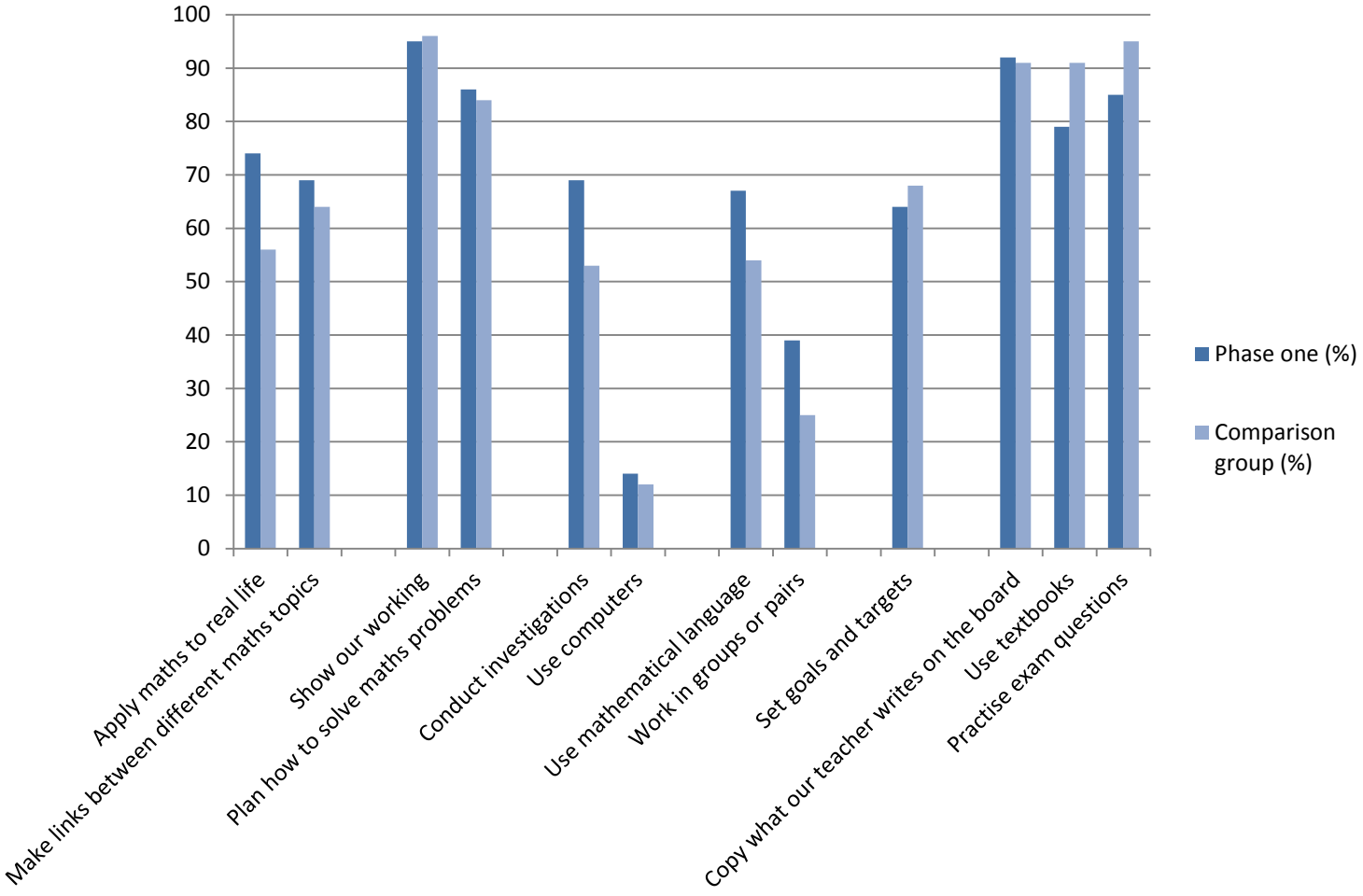

Figure 5.1 generally shows the expected pattern. In many of the mathematics teaching and learning approaches that are promoted within the revised syllabus, there are a higher proportion of positive responses from the phase one group than the comparison group. Correspondingly, in the more traditional areas there tends to a higher proportion of positive responses from the comparison group. Further analysis also reveals that, in many areas, these are statistically significant differences, indicating that there are meaningful variations in the types of mathematics activities

that each group has participated in. Students' perspectives in relation to each of these areas are discussed in further detail below.

5.1.1 Students' perspectives on learning approaches characteristic of the revised syllabus

This section explores students' perspectives on the learning approaches they have experienced in their mathematics lessons.

Applying mathematics

Key messages

Students following the revised mathematics syllabus appear to **apply their learning to real-life situations** more frequently than those following the previous syllabus.

They also appeared to **make connections between mathematics topics** more frequently than their peers, suggesting that the revised syllabus is encouraging students to develop their synthesis skills.

Phase one students reported particularly strongly, relative to their comparison group peers, they that regularly **applied their learning**, to both real-life situations and to other mathematics topics. This reflects the prominence of students' ability to situate their mathematical knowledge within realistic contexts as a learning outcome of the revised syllabus.

Table 5.1 shows, for example, that almost three-quarters of phase one students (74 per cent) reported that they **applied their learning in mathematics to real-life situations** 'sometimes' (45 per cent) or 'often' (29 per cent), compared to just over half (56 per cent) of comparison group students who reported that they do this 'sometimes' (45 per cent) or 'often' (11 per cent).

Table 5.1: We apply what we learn in maths to real life situations

	Phase one %	Comparison group %
Often	29	11
Sometimes	45	45
Rarely	17	33
Never	6	8
No Response	2	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 367 phase one students, and 2,361 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

This is a statistically significant difference and demonstrates that, whilst the same proportion of students in both groups feel they sometimes apply their learning in mathematics to real-life situations, a much higher proportion of phase one students, relative to the comparison group, feel that they do this often. As the application of mathematics to real-life contexts is a central feature of the revised mathematics syllabus, this provides a clear indication that such approaches are being effectively translated into classroom practice, and that students recognise this as a distinct aspect of their learning.

Likewise, when asked how frequently they **made links between different mathematics topics**, there was a statistically significant difference between the responses of phase one and comparison group students. The findings are presented in Table 5.2:

Table 5.2: We make links between different maths topics

	Phase one %	Comparison group %
Often	27	19
Sometimes	42	45
Rarely	21	23
Never	6	10
No Response	3	2
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 367 phase one students, and 2,361 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 5.2 shows that whilst similar proportions of phase one and comparison group students reported that they make links between different mathematics topics 'sometimes' (42 per cent of phase one students, and 45 per cent of comparison group students), a considerably higher proportion of phase one students reported that they did this 'often' (27 per cent of phase one students, compared to 19 per cent of comparison group students). This suggests that the revised syllabus is having a positive impact in encouraging phase one students to synthesise their mathematical knowledge, and to draw on a range of different topics and contexts to solve mathematical problems.

Knowledge of the processes underpinning mathematics

Key messages

The vast majority of students following the revised syllabus reported that they regularly take part in activities aimed at developing their knowledge and understanding of the **processes underpinning mathematics**. This included activities such as **showing their working to justify their answers**, and **planning how to solve mathematics problems**.

A similarly high proportion of students following the previous syllabus also reported that this was the case. This suggests that the approaches promoted throughout the revised syllabus are complementing, rather than replacing, established techniques within school.

Figure 5.1 also shows that students reported strongly that they had participated in those teaching and learning activities aiming to support their understanding of **the processes underpinning mathematics**, although in this area there was less of a distinction between phase one and comparison group students. For example, whilst

the vast majority (95 per cent) of phase one students reported that they **show their working to justify their answers** 'sometimes' or 'often', a similar proportion of comparison group students (96 per cent) also reported that this was the case. This is not a statistically significant difference, indicating that the revised syllabus has not impacted upon students in relation to this area. However, as the proportion of students in both groups reporting that they regularly show their working to justify their answers is very high, it appears that this approach is already well embedded within schools (since the introduction of the previous syllabus in 2000, students at Junior Certificate level have been required to show their working in examination questions to support their answers, but not necessarily to justify their conclusions) (Appendix B, Table 1).

As shown in Table 5.3, the vast majority of phase one students also reported that they **think about mathematics problems and plan how to solve them** in lessons, reflecting the emphasis placed on exploring the 'how' and the 'why' of mathematics within the revised syllabus.

Table 5.3: We think about maths problems and plan how to solve them

	Phase one %	Comparison group %
Often	55	50
Sometimes	31	34
Rarely	9	12
Never	2	4
No Response	3	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 367 phase one students, and 2,361 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 5.3 shows that the vast majority (86 per cent) of phase one students reported that they think about mathematics problems and plan how to solve them 'sometimes' (31 per cent) or 'often' (55 per cent), compared to 84 per cent of comparison group students who reported that they do this 'sometimes' (34 per cent) or 'often' (50 per cent). Whilst there is a statistically significant difference between the two groups, both phase one and comparison group students gave a similar distribution of responses. This suggests that students following both the revised and previous versions of the mathematics syllabus are encouraged to participate in this type of approach during lessons.

Participation in investigative, practical activities

Key messages

Students following the revised syllabus appear to be taking a **hands-on approach** to learning mathematics. The majority of students following the revised syllabus reported that they **regularly conduct investigations** to solve mathematical problems, and appeared to do so more often than those following the previous syllabus.

Use of **information technology (IT) in mathematics lessons appeared to be limited** amongst students following both syllabuses, although those following the revised syllabus appeared to use computers in mathematics lessons to help them solve problems more often than their peers.

Similarly, Figure 5.1 shows that a higher proportion of phase one students reported that they regularly take part in investigations and practical activities in mathematics lessons, than their comparison group peers. This is an encouraging indication that the hands-on emphasis of the revised syllabus, characterised by participation in interactive, problem-solving activities, is being translated in the classroom. However, there was considerable variation in the extent to which different aspects of this approach were being applied.

For example, Table 5.4 shows that the majority of students in the phase one group (69 per cent) reported that they conduct investigations to solve mathematical problems 'sometimes' (34 per cent) or 'often' (35 per cent). Comparison group students reported that they did this considerably less frequently: just over half (53 per cent) reported that they did this 'sometimes' (30 per cent) or 'often' (23 per cent).

Table 5.4: We do investigations to solve maths problems

	Phase one %	Comparison group %
Often	35	23
Sometimes	34	30
Rarely	19	26
Never	7	19
No Response	3	2
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 367 phase one students, and 2,361 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

This difference is statistically significant and demonstrates that whilst similar proportions of phase one and comparison group students feel that they sometimes conduct investigations to solve mathematics problems, a higher proportion of phase one students feel that they do this often.

By contrast, as shown in Table 5.5, when asked how often they **used computers in mathematics lessons to help them solve problems**, far fewer students reported that they had taken this approach. This suggests that the use of information technology (IT) as a classroom learning tool in mathematics is, in general, limited.

Table 5.5: We use computers in maths lessons to help us solve problems

	Phase one %	Comparison group %
Often	3	3
Sometimes	11	9
Rarely	27	17
Never	57	69
No Response	3	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 367 phase one students, and 2,361 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 5.5 shows that there was a statistically significant difference between the responses of phase one and comparison groups students when asked how frequently they used computers in mathematics to help them solve problems, with phase one students reporting that they used computers more frequently than their comparison group counterparts. However, just 14 per cent of phase one students reported that they used computers in mathematics 'sometimes' (11 per cent) or 'often' (three per cent). By contrast, 12 per cent of comparison group students reported that they did this 'sometimes' (nine per cent) or 'often' (three per cent). This suggests that, whilst the revised syllabuses appear to have had a positive impact on the frequency of students' use of IT in mathematics, there is still considerable room for the use of such resources to be increased.

Participation in discursive and collaborative activities

Key messages

There is considerable variation in the frequency with which students participate in discursive and collaborative activities. Students following both syllabuses appear more likely to **participate in discussion about mathematics as a whole class**, than they are to work together in small groups or pairs.

However, students following the revised syllabus report that do both types of activity more frequently than those following the previous syllabus. This indicates that such approaches are growing in prominence.

Figure 5.1 also shows that there is considerable variation in the regularity with which students participate in discursive and collaborative activities. The findings suggest that across both phase one and comparison groups, students are more likely to participate in discussion about mathematics as a whole class, than they are to work collaboratively in small groups or pairs. However, phase one students report that they participate in both of these activities more frequently than their comparison group peers, indicating that such approaches have become more prominent with the introduction of the new syllabus.

For example, as shown in Table 5.6, phase one students reported that they **talk about their ideas using the language of mathematics** in lessons more frequently than comparison group students.

Table 5.6: We talk about our ideas using the language of maths

	Phase one %	Comparison group %
Often	30	19
Sometimes	37	35
Rarely	20	27
Never	10	18
No Response	3	2
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 367 phase one students, and 2,361 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 5.6 shows that over two-thirds (67 per cent) of phase one students talk about their ideas using the language of mathematics 'sometimes' (37 per cent) or 'often' (30

per cent), compared to just over half (54 per cent) of comparison group students who reported that they do this 'sometimes' (35 per cent) or 'often' (19 per cent).

Again, this difference is statistically significant, and demonstrates that whilst similar proportions of phase one and comparison group students feel they sometimes talk about their ideas using the language of mathematics in lessons, a much higher proportion of phase one students, relative to the comparison group, feel that they do this often. This suggests that students following the revised syllabus are more frequently engaging in discursive activities in the classroom, and are being encouraged to develop their mathematical reasoning skills.

A considerably lower proportion of students in both phase one and comparison groups, however, reported that they regularly **work together in small groups or pairs**, relative to other areas. The findings are presented in Table 5.7:

Table 5.7: We work together in small groups or pairs

	Phase one %	Comparison group %
Often	14	8
Sometimes	25	17
Rarely	31	30
Never	28	44
No Response	2	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 367 phase one students, and 2,361 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 5.7 shows that, whilst phase one students reported that they work together in small groups or pairs more frequently than their comparison group peers, this remains relatively uncommon: almost three-fifths (59 per cent) of phase one students reported that they 'rarely' (31 per cent) or 'never' (28 per cent) do this, compared to just under three-quarters (74 per cent) of comparison group students who reported that they do this 'rarely' (30 per cent) or 'never' (44 per cent). As this approach is actively promoted within the revised syllabus, it is encouraging that phase one students report they are doing this with more regularity than students in the comparison group. However, the approach does not yet appear to be particularly widespread.

Becoming active learners

Key messages

The majority of students following the revised and previous syllabuses reported that they regularly **set goals and targets** about their mathematics learning.

This is a highly positive reflection of students' experiences of learning mathematics. However, there does not appear to be any discernible difference between the frequency with students following the revised syllabus undertake this activity and their peers.

The majority of phase one students (64 per cent) reported that they **set goals and targets about their mathematics learning** 'sometimes' or 'often', compared to 68 per cent of comparison group students. Whilst this suggests that students following the revised syllabus actually do this slightly less frequently than their comparison group peers, the difference between the two groups is not statistically significant. This indicates that the revised syllabus has not impacted upon students in relation to this particular approach (Appendix B, Table 2).

5.1.2 Students' perspectives on learning approaches characteristic of a more traditional syllabus

Key messages

Whilst students appear to be using many of the approaches promoted through the revised syllabus, a high proportion of students following the revised syllabus also report that they **regularly participate in activities associated with more traditional approaches to mathematics teaching and learning**.

This includes, for example, copying what their teacher writes on the board and working from textbooks in lessons. In some cases, students following the revised syllabus appeared to take part in these types of activities less frequently than those following the previous syllabus, and in other cases more so. This suggests a **degree of variability in the extent to which the revised syllabus has impacted upon the use of traditional approaches** to the teaching and learning of mathematics in the classroom.

Figure 5.1 also shows that, although there are positive indications that the approaches promoted through the revised syllabus are being reflected in the classroom, there remains a high proportion of phase one pupils who report that they participate in activities associated with more traditional approaches to mathematics teaching and learning.

Most notably, as shown in Table 5.8, when students were asked how often they **copy what their teacher writes on the board then practise using examples**, phase one students reported that they did this more commonly than their comparison group peers.

Table 5.8: We copy what our teacher writes on the board then practice using examples

	Phase one	Comparison group
	%	%
Often	62	68
Sometimes	30	23
Rarely	4	6
Never	2	1
No Response	2	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 367 phase one students, and 2,361 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 5.8 shows that 92 per cent of the phase one group reported that they did this 'sometimes' (30 per cent) or 'often' (62 per cent), compared to 91 per cent of the comparison group who reported that they did this 'sometimes' (23 per cent) or 'often' (68 per cent). There is a statistically significant difference between the responses of these two groups (although it is not clear where this statistical significance lies), which appears to be inconsistent with the approaches promoted throughout the revised syllabus, as well as with students' perceptions about such aspects of their learning.

A reasonably high proportion of students in both phase one and comparison groups reported that they **use textbooks in lessons and then practise what they have learned, either in class or for homework**; although phase one students appeared to do this less frequently than their comparison group peers. The findings are presented in Table 5.9:

Table 5.9: We use textbooks in lessons then practise what we have learned in class and/or for homework

	Phase one	Comparison group
	%	%
Often	60	77
Sometimes	19	14
Rarely	12	6
Never	6	2
No Response	3	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 367 phase one students, and 2,361 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 5.9 shows that a total of 79 per cent of phase one students reported that they do this 'sometimes' (19 per cent) or 'often' (60 per cent). By contrast, 91 per cent of comparison group students reported that they do this 'sometimes' (14 per cent) or 'often' (77 per cent). This difference is statistically significant. Similarly, as shown, in Table 5.10, a lower proportion of phase one students, relative to the comparison group, reported that they regularly **practise examination questions in class**.

Table 5.10: We practise exam questions in class

	Phase one	Comparison group
	%	%
Often	55	80
Sometimes	30	15
Rarely	10	3
Never	2	1
No Response	3	2
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 367 phase one students, and 2,361 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 5.10 shows that overall, 85 per cent of phase one students reported that they did this 'sometimes' (30 per cent) or 'often' (55 per cent), compared to 95 per cent of comparison group students who reported that they did this 'sometimes' (15 per cent) or 'often' (80 per cent). Again, this is a statistically significant difference.

As such approaches are considered to be characteristic of a more traditional perspective on mathematics teaching and learning, rather than of the revised syllabus, it is encouraging to find that, generally, a lower proportion of phase one students report that they regularly participate in these activities. Nonetheless, phase one students' participation in these activities remains high. This may be underpinned by a range of possible explanations: one such possibility may be that as the revised syllabus is relatively new, there remain concerns about examination content and format, leading schools to use more familiar methods of supporting young people to achieve examination success, whilst simultaneously promoting and delivering many of the features of the revised syllabus. This will be explored in further detail during the case-study phase.

5.1.3 Students' perspectives on mathematics teaching approaches

Key messages

Students who were following both the revised and previous versions of the mathematics syllabus were **highly positive about the mathematics teaching they had experienced**, and expressed broadly similar views.

Whilst this suggests that the revised syllabus does not appear to have impacted significantly on students' perceptions of the ways that their teachers support their learning, it positively reflects students' general satisfaction with their classroom teaching.

Given that the introduction of the revised syllabus marks a considerable shift in the way that mathematics is taught, requiring schools to familiarise themselves with a range of new topic areas and teaching approaches, it would not have been surprising to see a decrease in students' satisfaction with their learning experiences. It is therefore **encouraging that students' views remain so positive**.

In addition to questions exploring their perspectives on the approaches used to facilitate their learning, students were also asked about how their teachers were helping and supporting them in their mathematics classes, as an indicator of their experiences of the *teaching approaches* promoted throughout the revised syllabus. This question aimed to elicit students' views on the ease with which teachers have been able to apply the principles of the revised syllabus, rather than to assess or judge individual teacher quality. Specifically, students were asked about their teachers':

- capacity to set them work that reflected their abilities and interests, and to challenge and improve their skills
- ability to explain to students what they expect them to do, and support them in areas they are finding difficult
- ability to present mathematics in a way that is interesting
- confidence in students' abilities.

The responses of both phase one and comparison group students were highly positive, reflecting students' general satisfaction with their classroom teaching. However, the revised syllabus does not appear to have had impacted significantly on students' perceptions of the ways that their teachers are able to support them in their learning. However, given the many changes in teaching approaches that schools have implemented following the introduction of the revised mathematics syllabus (as identified throughout this section), it is to phase one schools' credit that their students' positive perceptions of teaching closely reflect those of the comparison group, who are following a syllabus with more established teaching approaches (Appendix B, Tables 3-10).

5.1.4 Discussion

The responses of students following the revised mathematics syllabus provide an encouraging indication that in many areas, the approaches promoted throughout the Project Maths initiative are being felt by students. The survey cannot tell us, however, the extent to which students' experiences are shaped by differences in their approaches to *learning* (underpinned by the structure, format and content of the revised mathematics syllabus), or whether it is instead a reflection of the nature of the *teaching* they receive. For example, are students finding connections between different mathematics topics as a result of their own learning process, or are they instead replicating knowledge passed on by their teachers, who already understand and appreciate these links?

Additionally, this section raises interesting questions regarding the extent to which schools are *able* to implement some of the approaches promoted throughout the revised syllabus. For example, students' use of IT in mathematics lessons may be affected by a range of factors, such as availability of facilities or resources specifically relating to the Project Maths initiative. These issues, and others relating to students' experiences of learning mathematics, will be explored further during the case-study phase.

5.2 Students' attitudes towards learning mathematics

This section explores students' attitudes towards learning mathematics, both generally and in relation to the individual strands of the revised mathematics syllabus.

5.2.1 Attitudes towards individual strands of the revised mathematics syllabus

To gain a more in-depth understanding of students' confidence in relation to the individual strands of the revised syllabus, students were asked about how confident they would feel when undertaking a range of different activities during their mathematics lessons. This includes students' confidence in relation to:

- Strand 1, measured by their confidence in working out the probability of an event occurring, and in drawing charts to display data, including pie charts and bar charts
- Strand 2, measured by their confidence in solving problems using trigonometry, making different shapes, and solving problems using the properties of different shapes
- Strand 3, measured by their confidence in understanding indices, and using formulae to solve problems in measurement
- Strand 4, measured by their confidence in solving problems using algebra,
- Strand 5, measured by their confidence to represent relationships between numbers graphically.

Students were also asked about their confidence to undertake mathematics activities embedded within all strands of the revised syllabus. This included students' confidence in using mathematics to solve problems based on real-life situations; solving mathematics problems using what they have learned in more than one mathematics topic; and gathering together information from a range of sources, and applying it to solving mathematical problems.

An overview of students' perspectives in relation to each of these areas is presented in Figure 5.2:

Figure 5.2: Proportion of Junior Certificate students reporting that they would find it 'very easy' or 'easy' if they were asked to solve problems in each of the following areas

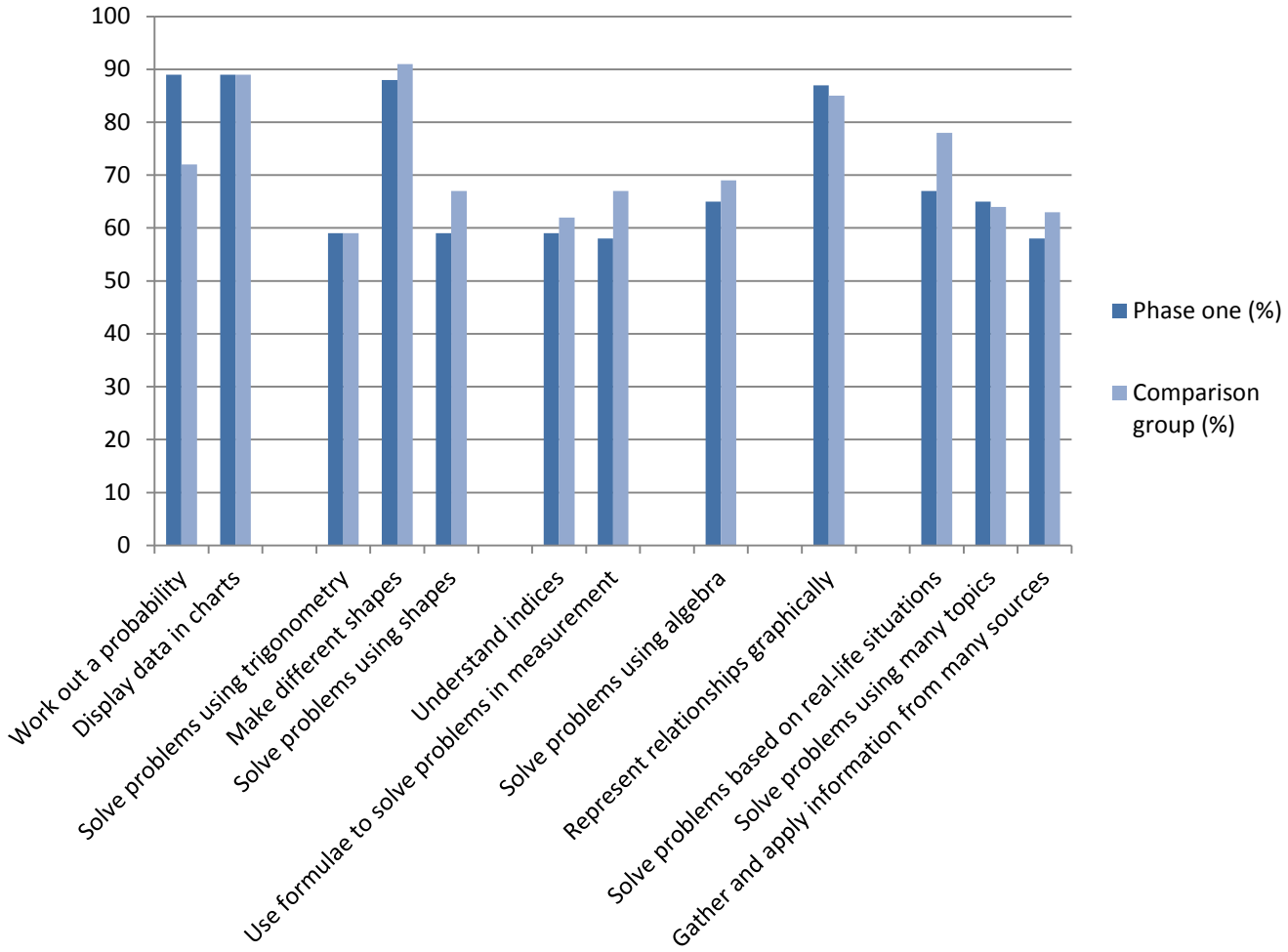

Figure 5.2 shows that both phase one and comparison group students are broadly confident in their abilities in topics spanning all strands of the revised syllabus. Furthermore, it indicates that in most areas, the views of phase one and comparison group students are similar. However, there is a notable difference in relation to calculating probabilities, which is a key aspect of Strand 1, Statistics and Probability. Here, phase one students appear to be more confident than their comparison group peers. These findings, and others, are explored by individual strand in the following sections.

5.2.2 Strand 1: Statistics and Probability

Key messages

Junior Certificate students who had following the revised syllabus, as well as their peers following the previous syllabus, **appeared highly confident in items relating to Strand 1, Statistics and Probability**.

Students who had followed the revised syllabus appeared more confident than their peers in **calculating the probability of an event occurring**, with over a quarter more students reporting that they would find it 'very easy' to do this. This is an encouraging finding, indicating that the approaches used to support young people in their understanding are being successfully applied.

Students were asked how confident they would feel to work out the probability of an event occurring. The findings are presented in Table 5.11.

Table 5.11: If I were asked to work out the probability of something happening...

	Phase one %	Comparison group %
I would find it very easy	61	37
I would find it easy	28	35
I would find it a little difficult	7	21
I would find it very difficult	2	6
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 375 phase one students, and 2,375 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 5.11 shows that phase one students are highly confident at calculating the probability of an event occurring, and more confident than their comparison group peers:

- the vast majority of phase one students (89 per cent) reported that they would find it 'easy' (28 per cent) or 'very easy' (61 per cent) to calculate the probability of an event occurring

- by contrast, just under three-quarters (72 per cent) of comparison group students reported that they would find it 'easy' (35 per cent) or 'very easy' (37 per cent)
- whilst just nine per cent of phase one students reported that they would find it 'a little difficult' (seven per cent) or 'very difficult' (two per cent) to calculate the probability of an event occurring, over one-quarter (27 per cent) of comparison group students reported that this was case, with 21 per cent reporting they would find it 'a little difficult' and six per cent 'very difficult'.

These differences are statistically significant, and demonstrate considerable positive impacts of the revised syllabus for this strand. The revised syllabus emphasises probability to a far greater extent than the previous mathematics syllabus, so it is encouraging that phase one students are highly confident in this area, both as an absolute measure, and relative to the comparison group.

However, there was no statistically significant difference between the responses of phase one and comparison group students in relation to other aspects of Strand 1, for example, confidence in **drawing charts to display data, including pie charts and bar charts,** although responses were largely positive (over 89 per cent of both phase one and comparison group students reported that they would find this 'easy' or 'very easy', with over half (54 per cent of both groups) reporting that they would find this 'very easy' (Appendix B, Table 11).

5.2.3 Strand 2: Geometry and Trigonometry

Key messages

Again, Junior Certificate students appeared to be **broadly confident in their understanding in relation to Strand 2, Geometry and Trigonometry**. Both groups of students, however, reported lower levels of confidence than they did for Strand 1, Statistics and Probability.

In some areas, Junior Certificate students following the revised syllabus appeared to be less confident than those who had followed the previous syllabus: for instance, to make different shapes, and to solve problems using the properties of different shapes. This suggests that there may be room for students' confidence in Strand 2 to be further developed, albeit from a high baseline.

In general, students in both phase one and comparison groups were less confident in relation to Strand 2 of the revised syllabus than they were in Strand 1.

In relation to trigonometry, students were asked how confident they would feel to **solve problems using trigonometry**. The findings revealed that there was no statistically significant difference between the responses of phase one students and their comparison group peers, with just under three-fifths (59 per cent) of both phase one and comparison group students reporting that they would find it 'easy' or 'very

easy' to solve problems using trigonometry. This suggests that the revised syllabus has not yet positively influenced students' trigonometry skills (Appendix B, Table 12).

There were, however, statistically significant differences between phase one and comparison groups when asked how confident they would feel to **make different shapes** (for example, to draw a triangle with sides of length 3cm, 5cm and 8cm). The findings are presented in Table 5.12.

Table 5.12: If I were asked to make different shapes...

	Phase one %	Comparison group %
I would find it very easy	62	69
I would find it easy	26	22
I would find it a little difficult	9	7
I would find it very difficult	1	1
No response	2	2
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 375 phase one students, and 2,375 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 5.12 shows that both groups of students are, overall, highly confident in this area. However, phase one students are statistically less confident than their comparison group peers in this area: 88 per cent of phase one students reported that they would find it 'easy' (26 per cent) or 'very easy' (62 per cent). By contrast, 91 per cent of comparison group students reported that they would find this 'easy' (22 per cent) or 'very easy' (69 per cent).

Taking this one step further, students were then asked how confident they would feel to **solve problems using the properties of different shapes** (for example, to find the surface area and volume of a range of solids). The findings are presented in Table 5.13:

Table 5.13: If I were asked to solve problems using the properties of different shapes...

	Phase one %	Comparison group %
I would find it very easy	22	30
I would find it easy	37	37
I would find it a little difficult	33	27
I would find it very difficult	8	6
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 375 phase one students, and 2,375 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 5.13 shows that, again, students in both groups were generally less confident about their ability to solve problems using the properties of different shapes than they were to approach the mathematics problems posed in relation to Strand 1, and phase one students were less confident than their comparison group peers:

- just under three-fifths (59 per cent) of phase one students reported that they would find it 'easy' (37 per cent) or 'very easy' (22 per cent) to solve problems using the properties of different shapes
- just over two-thirds (67 per cent) of comparison group students reported that they would find this 'easy' (37 per cent) or 'very easy' (30 per cent).

Again, this is statistically significant and suggests that, to date, the revised syllabus has not yet had a positive impact on students' confidence in relation to geometry, and specifically in the use of shape. Therefore, there may be a need for further development in this area.

5.2.4 Strand 3: Number

Key messages

In general, confidence was high amongst both groups of Junior Certificate students in items relating to Strand 3 (Number), although again, they did not appear to have the same degree of confidence exhibited in items relating to Strand 1 (Statistics and Probability).

There were some areas in which students following the revised syllabus appeared to be less confident than those who had followed the previous syllabus. Students following the revised syllabus reported that they were less confident, for example, in relation to their ability to use formulae to solve problems in measurement.

Students' responses to questions relating to their confidence in Strand 3 of the revised syllabus suggest that, in some areas, it does not appear to have made any difference to students' confidence in relation to Number. In other areas, however, phase one students appeared less confident than their comparison group peers.

Students were asked how confident they felt at **understanding indices**, for example, simplifying the equation $5^3 \times 5^4$. The findings reveal that the difference between phase one students and comparison group students is not statistically significant. Around three-fifths of students (59 per cent of phase one students, and 62 per cent of comparison group students) reported that they would find it 'easy' or 'very easy' to understand indices. This suggests that the revised syllabus has not positively influenced students' confidence in this area (Appendix B, Table 13).

Students were also asked how confident they would feel to **use formulae to solve problems in measurement**: for example, to find the speed of a car that travelled a distance of 100km in 1.5 hours, and the differences were statistically significant. The findings are presented in Table 5.14.

Table 5.14: If I were asked to use formulae to solve problems in measurement...

	Phase one %	Comparison group %
I would find it very easy	21	30
I would find it easy	37	37
I would find it a little difficult	34	26
I would find it very difficult	5	6
No response	2	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 375 phase one students, and 2,375 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 5.14 shows that:

- just under three-fifths (58 per cent) of phase one students reported that they would find it 'easy' (37 per cent) or 'very easy' (21 per cent) to use formulae to solve problems in measurement
- just over two-thirds (67 per cent) of comparison group students reported that they would find this 'easy' (37 per cent) or 'very easy' (30 per cent)

The findings show that phase one students are, in relation to this particular part of Strand 3, less confident than their comparison group peers.

5.2.5 Strand 4: Algebra

Key messages

Although the **majority of Junior Certificate students in both groups reported that they were confident to solve problems using algebra, a lower proportion of those following the revised syllabus reported that this was the case**. This indicates that students who have studied Strand 4 (Algebra), as part of the revised syllabus are finding this more challenging. This reflects the findings from the assessment part of this research, which suggest that students find algebra to be difficult relative to other areas.

Students were asked how confident they would feel to **solve problems using algebra**: for example, to find the value of x when 4x+3 = 2x+11. The findings are presented in Table 5.15.

Table 5.15: If I were asked to solve problems using algebra…

	Phase one %	Comparison group %
I would find it very easy	29	39
I would find it easy	36	30
I would find it a little difficult	24	20
I would find it very difficult	10	10
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 375 phase one students, and 2,375 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 5.15 shows that:

- just under two-thirds (65 per cent) of students in phase one schools reported that they would find it 'easy' (36 per cent) or 'very easy' (29 per cent) to solve problems using algebra
- by contrast just over two-thirds (69 per cent) of students in comparison group schools, reported that they would find this 'easy' (30 per cent) or 'very easy' (39 per cent)

Whilst these findings overall positively reflect students' confidence in solving problems using algebra, there is a statistically significant difference between the two groups. This indicates that, in general, phase one students found algebra more challenging than students in the comparison group. The reasons for this will be explored further during the case-study phase. For example, the two groups may take different approaches interpreting this type of question, which could explain any differences in students' confidence.

5.2.6 Strand 5: Functions

Key messages

Neither of the Junior Certificate groups responding to the survey had studied Strand 5 of the revised syllabus, Functions. Despite this, **both groups of students reported that they were highly and similarly confident to represent relationships between numbers graphically**. This suggests that schools can feel confident in their students' capabilities when introducing Strand 5 of the syllabus.

In relation to Strand 5 of the revised syllabus, students were asked how confident they would feel to **represent relationships between numbers graphically**. Both groups of students reported that they were confident in this area, despite neither group having studied Strand 5 of the revised mathematics syllabus (although there is considerable overlap between this strand and Strand 4, Algebra). Overall, 87 per cent of phase one students reported that they would find this 'easy' (32 per cent) or 'very easy' (55 per cent) Overall, 85 per cent of comparison group students reported that they would find this 'easy' (31 per cent) or 'very easy' (54 per cent). However, there was no statistically significant difference between the responses of the two groups. This is to be expected given the similarity of their experiences in this area, as none of the students responding to the survey had studied this strand of the revised syllabus (Appendix B, Table 14).

5.2.7 All strands: Synthesis and problem solving

Key messages

In general, both phase one and comparison group students reported that they were **confident in solving problems based on real-life situations**. Phase one students, however, appeared to feel somewhat less confident than their comparison group peers.

Similarly, the majority of phase one students reported that they were confident in their ability to synthesise what they have learned in more than one topic and apply it to solving a range of mathematical problems, and to gather together information from a range of sources, and apply it to solving mathematical problems, with comparison group students reporting similar levels of confidence. The **findings suggest that the revised mathematics syllabus has not yet positively impacted on phase one students' abilities in each of the areas described**.

This is particularly notable in relation to the application of mathematics to real-life situations, as students in the phase one group reported that they had applied mathematics to real-life situations much more commonly than the comparison group. The reasons for this disparity are not yet understood, and will therefore be explored further during the case-study phase.

Across all strands of the revised syllabus, students are expected to be able to **use mathematics to solve problems based on real-life situations**. The findings relating to this area are presented in Table 5.16:

Table 5.16: If I were asked to use mathematics to solve problems based on real-life situations...

	Phase one %	Comparison group %
I would find it very easy	22	31
I would find it easy	45	47
I would find it a little difficult	29	19
I would find it very difficult	4	2
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 374 phase one students, and 2,364 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 5.16 shows that:

- in general, both phase one and comparison group students reported that they were confident in this area. Phase one students, however, appeared to feel somewhat less confident than their comparison group peers
- just over two-thirds (67 per cent) of phase one students reported that they would find this 'easy' (45 per cent) or 'very easy' (22 per cent), compared to almost four-fifths (78 per cent) of comparison group students who reported that they would find this 'easy' (47 per cent) or 'very easy' (31 per cent).

This is a statistically significant difference, and is particularly notable as students in the phase one group reported that they applied mathematics to real-life situations much more commonly than the comparison group. One possible explanation for this is that, as phase one students have done this more regularly than their comparison group counterparts, they have been encouraged to test out and challenge their skills in this area, and apply their knowledge to more complex real-life contexts, more so than comparison group students. Likewise, it may also be possible that phase one and non-phase one students have differing understandings of what is meant by 'problem-solving', perhaps associating it with the application of newly learned techniques rather than real-life contexts (see Meehan and Paolucci (2009) for a further discussion of this issue).

Similarly, across all strands of the revised syllabus students are expected to demonstrate their ability to synthesise what they have learned in more than one topic, and apply it to solving a range of mathematical problems. Whilst just under

two-thirds (65 per cent) of phase one students reported that they would find it 'easy' (43 per cent) or 'very easy' (22 per cent) to solve **mathematics problems using what they have learned in more than one mathematics topic**, there was no statistical difference between the responses of phase one students and their comparison group peers (64 per cent of whom reported that they would find this 'easy' (41 per cent) or 'very easy' (23 per cent) (Appendix B, Table 15). Findings presented earlier in this report showed that phase one students more commonly make links between mathematics topics than the comparison group. Therefore, despite phase one students doing this type of activity more often, there is no apparent difference in student confidence between the two groups.

In both phase one and comparison group schools, students also appeared to find it challenging to **gather together information from a range of sources, and apply it to solving mathematical problems.** Overall, 58 per cent of phase one students report that they would find this 'easy' (43 per cent) or 'very easy' (15 per cent). By contrast, 63 per cent of comparison group students reported that they would find this 'easy' (45 per cent) or 'very easy' (18 per cent). However, there was no statistical difference between groups, suggesting that the revised syllabuses have not had an impact on students' skills in this area (Appendix B, Table 16).

5.2.8 General attitudes towards mathematics

Key messages

Both groups of Junior Certificate students appeared to have **highly positive attitudes towards mathematics in general**. This is indicative that the revised mathematics syllabus has been received positively by students, given that the approach is new to both students and teachers.

In order to understand students' perceptions of their own abilities and levels of engagement with mathematics, participating students were asked to comment on the extent of their agreement with a range of statements about learning mathematics. The areas explored included students':

- confidence in their own mathematical ability, and in their ability relative to their peers
- enjoyment of mathematics, and the process of learning mathematics
- interest in studying more mathematics in school.

Overall, students in both phase one and comparison groups reported similarly positive views about learning mathematics and in most areas, there were no statistically significant differences between the two groups (Appendix B, Tables 17-23), with the exception of students' **confidence in their mathematical ability relative to their peers**. In this case, phase one students appeared to be less

confident than comparison group students in their mathematical ability relative to their peers. Just over two-fifths (43 per cent) of phase one students agreed either 'a little' (27 per cent) or 'a lot' (16 per cent) when asked if mathematics was more difficult for them than many of their classmates. By contrast, just over one-third (37 per cent) of comparison group students agreed either 'a little' (23 per cent) or 'a lot' (14 per cent) that this was the case. Nonetheless, it should be recognised that, in both groups, the students who lacked confidence relative to their peers were in the minority: in most cases, students had a positive view of their abilities in this as well as other regards (Appendix B, Table 24).

This is indicative that the revised mathematics syllabus has been received positively by students and, given that the approach is new to both students and teachers, it is encouraging that students' confidence has not diminished in the early stages of the syllabus's implementation. This is particularly promising when situated within the context of students' perspectives on the difference in difficulty between mathematics at primary and Junior Certificate level: when students were asked how often they felt that the way they learned mathematics at Junior Certificate level was harder than mathematics in primary school, phase one students appeared to feel this more frequently than their comparison group peers. The vast majority (90 per cent) of phase one students reported that they found mathematics at Junior Certificate level to be harder than mathematics at primary school 'sometimes' (18 per cent) or 'often' (72 per cent), compared to 86 per cent of comparison group students who reported this 'sometimes' (23 per cent) or 'often' (63 per cent). There is a statistically significant difference between the two groups, and it is therefore encouraging that, although phase one students appear to have found the transition from primary school to junior cycle more challenging than comparison group students, their overall confidence levels remain high (Appendix B, Table 25).

5.2.9 Discussion

This section highlights that students feel confident in their abilities in many aspects of the revised syllabus, particularly in relation to Strand 1 (Statistics and Probability). It is not possible to determine from the survey findings, however, the ways in which schools have been able to foster such positive impacts for this strand. Therefore, a key issue for further exploration is to more fully understand how schools have arrived at such impacts, so that this learning may be transferred into other strands.

The data explored in this section indicates that in some areas, the frequency with which students participate in particular mathematics learning approaches do not always result in positive impacts on their confidence (for example, phase one students reported that they regularly apply their learning to real-life situations, but do not appear to be any more confident in doing so than their non-phase one peers). As discussed earlier in this chapter, it is possible that students following the revised syllabus are now more aware of the complexities and challenges of applying mathematics to real-life contexts, and are therefore more cautious in estimating their

abilities in this area. The case-study phase will allow for further consideration of this issue.

5.3 Students' attitudes towards careers involving mathematics

Key messages

Both groups of Junior Certificate students were in broad agreement that **mathematics was important in a range of contexts outside of the classroom** (e.g. in daily life). However, the revised syllabus does not appear to have significantly impacted on students' perspectives about the wider applications of mathematics, expressing relatively narrow perceptions of the range of careers involving mathematics.

To gain an understanding of students' attitudes towards careers involving mathematics, the survey explored students' knowledge of, and perspectives on:

- the wider application of mathematics beyond the classroom
- the range of jobs and career pathways involving mathematics.

5.3.1 Students' understanding of the wider application of mathematics

To ascertain the students' views on the broader application of mathematics beyond the classroom, they were asked to comment on the extent to which they perceived it to be useful in the following ways:

- to help in daily life
- to aid learning in other school subjects
- to enable them to get into the university of their choice
- to enable them to get the job of their choice.

The findings showed that, whilst both groups of students were in broad agreement that mathematics was important in each of these areas (between 70 per cent and 85 per cent of phase one students agreed 'a little' or 'a lot' that this was the case, as did between 69 per cent and 83 per cent of comparison group students), there were no statistically significant differences between phase one students and their comparison group peers in any of these areas. This suggests that the revised syllabus has not significantly impacted on phase one students' perspectives about the wider applications of mathematics (Appendix B, Tables 26-29).

5.3.2 Students' understanding of jobs involving mathematics

To explore students' understanding of jobs and career pathways involving mathematics, they were provided with a list of ten different professions, all involving mathematics in a variety of different ways. Students were then asked to select which of these roles involved using mathematics. These professions, in rank order according to the proportion of students indicating positively that they involve mathematics, are shown in Table 5.18.

Table 5.18: Proportion of students indicating that mathematics is involved in each profession

	Phase one students	Comparison group students
80-100 per cent	Owning a business	Owning a business
	Accountant	Accountant
	Engineer	Engineer
	Scientist	Scientist
	Sales assistant	Sales assistant
	Working with technology	Working with technology
40-60 per cent	Doctor	Doctor
	Fashion designer	Dietician
	Dietician	Fashion designer
< 40 per cent	Nurse	Nurse

Table 5.20 shows that there were no substantial differences between the students' views on which of these roles involve using mathematics. Perhaps unsurprisingly, students in both groups reported most strongly that this was the case for jobs involving a clear mathematical component (for example, **accountancy, or owning a business**): over 90 per cent of students in both phase one and comparison group schools identified that this was the case.

Next, students in both phase one and comparison groups strongly identified that careers in other science, technology, engineering and mathematics (STEM) subjects involved mathematics. This was reported most strongly in relation to **engineering and science** (where over 85 per cent of students in both phase one and comparison group schools identified that this was the case) and, to a slightly lesser extent, working with technology (over 80 per cent reported that that was the case in both groups). Students were less convinced, however, that careers in design involved

using mathematics (for example, becoming a **fashion designer**): just less than half of students reported that this was the case (48 per cent of phase one students, and 49 per cent of comparison group students).

Overall, students did not appear to perceive that careers in the **medical profession** involved using mathematics. Whilst just over half (57 per cent of both phase one and comparison groups) reported that being a doctor would require mathematics, just 37 per cent of both groups felt that the same would be true for nursing (Appendix B, Tables 30-39).

The similarities in the responses of phase one and comparison group students suggest that the revised syllabus has not, as yet, broadened students' perspectives on the range of professions that involve mathematics. This may, therefore, be an area which would benefit from further development.

5.3.3 Discussion

The findings presented in this section indicate that the introduction of the revised mathematics syllabus has not, to date, had any discernible impact on students' appreciation of the application of mathematics outside of the classroom (although in general, students in both phase one and non-phase one groups had broadly positive views in this regard). This suggests that, although phase one students reported having applied their learning to a range of contexts, this may not yet have impacted upon their appreciation of mathematics in the real world.

In addition, students' responses indicate a relatively narrow perception of the range of careers involving mathematics. One possible explanation for this may be that schools and students have not had sufficient opportunity within the syllabus timetable to discuss these career pathways, or to engage with individuals occupying these roles. This may, therefore, merit further exploration in subsequent parts of this research.

Part B

Achievement, learning and motivation of Leaving Certificate students

6. About the Leaving Certificate students

This section describes the profile of Leaving Certificate students who participated in the research, as a basis for further exploration in subsequent chapters. Chapter 7 presents the findings from the assessment of Leaving Certificate student achievement, and Chapter 8 the findings of the survey of Leaving Certificate students' attitudes towards mathematics

6.1 About the students

In total, 299 students from 19 phase one schools, and 2,004 students from 125 comparison group schools, completed the Leaving Certificate student attitude survey. A total of 370 students from the same phase one schools, and 722 students from 52 of the comparison group schools, completed the Leaving Certificate assessment of student performance.

6.2 Syllabus strands studied

Like the Junior Certificate students, participating Leaving Certificate students were in the examination class of 2012, and in the final year of their studies. Students had commenced their Leaving Certificate in September 2010: phase one students were, therefore, part of the third cohort of those following the revised mathematics syllabus. This group of students had studied all five strands of the revised syllabus, as follows:

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

Students in non-phase one schools were part of the first national cohort of the revised mathematics syllabus. These students had followed revised syllabuses for Strands 1 and 2, and for the remainder of their studies had followed the previous mathematics syllabus. Whilst they were not, therefore, a comparison group, students in this group had been less immersed in the revised syllabus than their phase one counterparts.

7. Achievement of Leaving Certificate students

This section presents the findings of the assessment of Leaving Certificate student achievement in phase one schools across all five strands of the revised mathematics syllabus. These findings are compared to the achievement of comparison group students, and to international standards. Key messages are highlighted in each of these sections.

As noted earlier for the Junior Certificate section of the report, when reading this section, it is important to bear in mind the earlier discussion about differences in the ages of the Irish students and the students participating in the international studies. The students who participated in PISA and TIMSS 2007 (two of the studies from which the evaluation's Leaving Certificate indicator items were taken) are younger (15 years and 13-14 years old respectively) than the Leaving Certificate students. Conversely, those who participated in TIMSS Advanced 2008 (a third study from which some items were drawn) are older than the Leaving Certificate students. However, PISA and TIMSS are the only major international comparison studies of mathematics achievement and, between them, they assess a range of mathematical concepts at appropriate and, in some cases, challenging levels of difficulty. In addition and despite the age differences, the test items administered in this stage of the evaluation will provide a useful baseline measure of students' achievement over time, as the evaluation progresses and the revised approaches become more established in schools.

7.1 Overview of achievement patterns

Student performance was mixed across the different strands of the syllabus. **Phase one students displayed proficiency in Strand 1, Statistics and Probability**: most of the items in this strand had high facilities.[14] **In contrast, performance was slightly weaker on Geometry and Trigonometry** and many items had low facilities. However, this may be partly due to the item styles used in this booklet. A number of Leaving Certificate items required a multiple choice response followed by a 'show your working' or 'explain your answer' section (while one of these multiple choice items was also in the Junior Certificate booklet, only the Leaving Certificate booklet contained the additional explanation or working section). Many students did not attempt to justify their answers, suggesting either that they were daunted by this request, or did not realise they needed to complete this to be awarded full marks.

[14] 'Facility' is a measure of the difficulty of an item, expressed as the percentage gaining credit for their answer.

Performance on Strand 3 (Number) and Strand 4 (Algebra) was mixed, with a wide range of facilities. Low item facilities on these two strands may be due to a range of factors. For example, some items assess a concept in a complex way that may have been beyond many students (but were included in order to provide appropriate challenge for the more advanced students). One example of this is item 6 in booklet ALC4 which assesses 'expressions' using a composite function. While composite functions are covered in the revised syllabus, simplifying this type of expression is more demanding than working with a single function. Leaving Certificate students appeared to find items relating to Strand 5 (Functions) of the revised syllabus, relatively difficult, even amongst Higher Level students.

Overall, **the results echoed the finding among Junior Certificate students, in that items requiring higher-order skills were more difficult**. In addition, even where an item assessed a concept that all students should be familiar with, they struggled if required to view the problem from a different viewpoint. An example of this is item 7 in booklet ALC4 which requires students to construct a quadratic function by working backwards from its roots.

The performance of **phase one and non-phase one students was broadly similar on Strands 1 and 2** (non-phase one students were not tested on Strands 3 to 5). However, this is to be expected, as both groups of students had been studying Strands 1 and 2 of the revised syllabus for the same amount of time. Phase one students scored significantly higher on an item that requires analysing verbal geometric information and translating it into mathematical form. However, it is unclear whether the two groups truly differ on this skill, as a similar item showed no differential performance.

Comparisons between the performance of phase one students and the available international data are confounded by a range of factors including, as outlined earlier, differences in age. The effects of these are difficult to quantify. However, given the characteristics of the student samples, we would broadly expect phase one Leaving Certificate students to outperform the international average on TIMSS 8th Grade items, and to perform somewhat less well than the international average on TIMSS Advanced items. In general, the results followed this pattern, though there were some exceptions. Phase one students performed better than expected on items where the solution strategy is clear, and where diagrams, if applicable, are provided. By contrast, they performed less well on multi-step items.

7.2 Performance in detail: phase one schools

Key messages

Student performance was mixed across the different strands of the syllabus. Overall, the results echoed those of Junior Certificate students, in that **items requiring higher order skills were found to be more difficult**.

A number of items required a multiple choice response followed by a 'show your working' section. **Many students did not attempt to justify their answers**, suggesting either that they were daunted by this request, or did not realise they needed to complete this section to be awarded full marks.

7.2.1 Strand 1: Statistics and Probability

In the phase one schools, 178 students completed the Strand 1 item indicator booklet (referred to throughout this section as SPLC1), which covered Statistics and Probability (for further details on the methods used, see chapter 2). Table 7.1 shows the performance of phase one students completing SPLC1[15]. For two mark items, the table shows the proportion of students who only achieved one mark, and the proportion who received both available marks. For each item, the table also provides the broad syllabus area assessed, and a summary of the task (see Appendix A, Table 5 for item performance on each item matched to the specific numbered area of the revised syllabus). The indicator item booklet covered the following aspects of the syllabus: 'concepts of probability' (1.2), 'outcomes of random processes' (1.3), 'statistical reasoning with an aim to becoming a statistically aware consumer' (1.4), and 'representing data graphically and numerically' (1.6). In general, students performed well on the items in this booklet. The range of facilities for all but one of the one mark items was between 49 and 80 per cent. However students performed very poorly on item 6 which showed a facility of one per cent.

[15] The table also shows the performance of non-phase one students.

Table 7.1: Item indicator booklet SPLC1 (Statistics and Probability) – student performance and summary of items

Item	Syllabus area	Item summary	Phase One Students		Non-phase One Students	
			1 mark (%)	2 marks (%)	1 mark (%)	2 marks (%)
1	Probability	Estimate probability of two independent events	61		62	
2	Probability	Interpret long-term probability of earthquake	67		62	
3	Statistical Reasoning	Recognise graph as potentially misleading	30	28	30	21
4	Probability	Estimate size of sectors on coloured spinner (from experimental data)	70		61	
5	Representing Data	Understand why bar graph is unsuitable for given data	66		56	
6	Statistical reasoning	Understand how data points relate to their average	1		1	
7a	Representing Data	Calculate and compare means from tabulated data	80		75	
7b	Representing Data	Draw conclusions from data in graphical form	37	42	34	39
8	Statistical reasoning	Compare quality of polls based on sampling methods	5	58	9	49
9	Statistical reasoning	Use graph to make mathematical argument	49		38	

Item 6 assesses 'statistical reasoning' (1.4), as do items 3, 8 and 9. The fact that students did much better on items 3, 8 and 9, (facilities of 1m: 30 2m: 28[16]; 1m: 5 2m: 58; and 49 per cent respectively), suggests that the difficulty of item 6 is not due to the topic in general, but is likely to be due to question content. In order to score one mark for item 6, students had to decide whether each of five statements was conclusive or not. Although there were high facilities on some of the individual statements, the last two statements were classified correctly by only 11 per cent and 19 per cent of students. As a result, very few students managed to get the correct answers for all five statements. This is a complex task as it requires students to fully understand how individual data points do or do not affect the average. Students must also be able to construct counter-examples for each of the five statements to realise that each conclusion cannot be drawn. Furthermore, their performance may have been influenced by the need to classify all five statements as *not* conclusive in order to gain full credit; students tend to expect such yes/no classification item types to have at least one response in each classification group and this may have confused those less confident in their knowledge.

7.2.2 Strand 2: Geometry and Trigonometry

In the phase one schools, 179 students completed the Strand 2 item indicator booklet (referred to throughout this section as GTLC2). This booklet contains items on Geometry and Trigonometry. In particular, the following syllabus areas were covered: 'synthetic geometry' (2.1), 'co-ordinate geometry' (2.2), and 'trigonometry' (2.3). Column four of Table 7.2 shows the performance of phase one students completing GTLC2, as well as the broad syllabus area assessed, and a summary of the task[17] (see Appendix A, Table 5 for performance on each item matched to the specific numbered area of the revised mathematics syllabus).

Facilities for these items show a slightly weaker performance overall than for statistics and probability (SPLC1). The range of facilities for the one mark items in this booklet was between 12 and 77 per cent. There were a number of items that students found particularly difficult and some of the two mark items showed very low facilities. Items with low facilities included: item 2b (facility 1m: 2 per cent 2m: 18 per cent), item 7 (facility 17 per cent), item 8b (facility 13 per cent), item 10a (facility 12 per cent), and item 10b (facility 1m: 10 per cent 2m: 1 per cent). Item 2b assesses 'synthetic geometry' (2.1). A stronger performance on other items covering this area of the syllabus indicates that the low facility may be due to question content. Phase one students found part a of this item much easier (facility 77 per cent). Item 2a is the original multiple choice TIMSS item, which requires students to determine the size of an angle inscribed in a hexagon. It requires students to show their working for item 2a. Students seemed to find the requirement to explain working difficult in this context.

[16] For items worth two marks, facilities are expressed as the percentage gaining exactly one mark and the percentage gaining full credit (two marks).
[17] The table also shows the performance of non-phase one students.

Table 7.2: Item indicator booklet GTLC2 (Geometry and Trigonometry) – student performance and summary of items

Item	Syllabus area	Item summary	Phase One Students		Non-phase One Students	
			1 mark (%)	2 marks (%)	1 mark (%)	2 marks (%)
1	Synthetic Geometry	Match complex description of shapes to diagram	59		48	
2a	Synthetic Geometry	Size of angle formed by diagonals of hexagon	77		68	
2b		Show working for 2a	2	18	3	10
3	Synthetic Geometry	Size of angle (sum to 180; vertically opposite angles)	51		47	
4	Synthetic Geometry	Size of angles (alternate angles; exterior angle theorem)	67		68	
5	Synthetic Geometry	Length of median of isosceles triangle	28		28	
6	Coordinate Geometry	Sum of slopes of equilateral triangle	34		41	
7	Coordinate Geometry	Investigate whether two lines are parallel	17		18	
8a	Trigonometry	Solve for x given value of sin 2x	31		25	
8b		Show working for 8a	13		14	
9	Coordinate Geometry	Prove two lines intersect at a common midpoint (diagonals of parallelogram)	8	22	6	30
10a	Trigonometry	Find the length of a chord of a circle (width of window in semi-circular room)	12		18	
10b		Show working for 10a	10	1	13	0

It is possible that some students merely estimated the size of the angle based on the diagram and therefore could not justify their choice. It may also have been the case that students could do the working out for part a in their head and so did not attempt part b. There was a high omission rate for part b of 49 per cent: the fact that so many students omitted this question so early in the assessment booklet suggests either that students found this style of question difficult or that they did not realise that a separate mark was awarded for working (the number of marks per question was not indicated in the assessment booklet). The norm in other tests is for partial credit to be awarded for working, albeit often only in cases where the final answer is incorrect.

A similar situation seems to be happening in item 8a and b, where there is also an original TIMSS multiple choice item followed by a new requirement to show working. Part a has a facility of 31 per cent, but this drops to 13 per cent for part b. However, it is likely that the topic area for item 8 is also less familiar to students. Item 8 and item 10 are the only items in the indicator booklet that assess 'trigonometry' (2.3) and both items show weak performance overall. Item 10 also consists of a TIMSS multiple choice item followed by a new request to 'show your working', but in this item, the facilities are even lower. Twelve per cent of students received a mark for 10a. This is even lower than the proportion expected by chance (for a multiple choice item of this type there is a one in four chance of guessing the correct answer). This suggests that this item has very effective distractors.[18] For part 10b, 11 per cent of students received at least one mark for partial working: they showed that 180 degrees divided by 10 is 18 degrees, thus establishing the first step in a trigonometry approach. However, only one per cent of students received two marks by following through with the remaining steps needed to work out the problem. This is a complex item, with a number of steps. It requires students to calculate the width of a flat window in a semi-circular room. This equates to calculating the length of a chord of a circle. In order to do this, students must recognise the need to bisect a sector of the circle to form two right-angled triangles. They must then apply the ratio for the sine of an angle to calculate the relevant length. Therefore, this item requires thorough knowledge of trigonometric ratios and the geometric properties of triangles. This item also benefits from the ability to construct an accurate diagram. The combination of all of these factors makes this a difficult item, which was clearly beyond the capabilities of the vast majority of phase one students.

The other item with a low facility was item 7, which assesses 'co-ordinate geometry' (2.2). Items 6 and 9, which also covered this topic area, had higher facilities (approximately 30 per cent), although as the facilities across all items on this topic are relatively low, it may be the case that this is also a topic area with which students are less familiar. Item 7 requires students to establish whether two lines are parallel. The low facility may be due in part to the fact that the slopes of the lines are deliberately very close in value and therefore appear parallel. Some students may

[18] 'Distractors' are the incorrect response options in a multiple choice item. These may include one or more responses related to common misconceptions, or errors that students are likely to make.

have relied on the appearance of the lines, rather than calculating the slopes using the appropriate formula.

7.2.3 Strand 3: Number

In the phase one schools, 185 students completed the Strand 3 booklet (referred to as NLC3). This booklet assesses students' understanding of Number, covering 'number systems' (3.1), 'length, area and volume (3.4)', and 'synthesis and problem solving skills' (3.5). Table 7.3 shows the performance of phase one students completing NLC3, as well as the broad syllabus area assessed, and a summary of the task[19] (see Appendix A, Table 5 for performance on each item matched to the specific numbered area of the revised syllabus). Facilities were mostly within the 20-80 per cent range. Students found two items more difficult: item 7 (facility 18 per cent) and item 10 (facility 14 per cent). Both item 7 and item 10 cover the same area of the syllabus: 'number systems' (3.1). The same topic is covered in items 2, 6, 8a, and 8b. Overall, the students did better in these four items (facilities 29-59 per cent), but generally performance appears to be quite weak in this topic area. Item 7 asked students to give the sum of an infinite geometric series. Many students selected option 2 (48 per cent of students), rather than the correct option 4 (18 per cent of students). The sum in option 2 used 3 as a denominator, which also featured in the question stem, and it may be a sign that students were using guess work for this question. (None of the other options included the number 3.)

Table 7.3: Item indicator booklet NLC3 (Number) – Student performance and summary of items

Item	Syllabus area	Item summary	Phase One Students	
			1 mark (%)	2 marks (%)
1	Area	Find area of square floor	82	
2	Percentages	Design system of coins under set conditions	29	
3	Area	Compare surface area of regular and irregular shapes	42	
4	Length	Estimate perimeter of regular shapes	33	14
5	Problem-solving	Find how many bookshelves can be made from constituent parts available	71	
6	Operations	Find thickness of paper folded multiple times	35	
7	Geometric series	Find sum of infinite geometric series	18	
8a	Patterns	Recognise pattern present in flashes of lighthouse	59	
8b	Patterns	Construct pattern of lighthouse flashes under set conditions	11	25
9	Area	Estimate how many people fit in a field of given dimensions	23	
10	Induction	State the steps required for proof by induction	14	

[19] Non-phase one students only completed the first two booklets. Therefore they are not included in this table or in the tables for booklets ALC4 or FLC5.

Item 10 required students to describe the necessary steps to prove a mathematical statement by induction. The item has a high omission rate: 61 per cent of students did not respond to this question, although the fact that this question was at the end of the assessment booklet might partially explain this. In addition, this open style of questioning may be more difficult for students, albeit a core element of the revised syllabus.

7.2.4 Strand 4: Algebra

In the phase one schools, 186 students completed the Strand 4 booklet (referred to as ALC4), focusing on Algebra. Table 7.4 below shows the performance of phase one students completing ALC4, as well as the broad syllabus area assessed, and a summary of the task (see Appendix A, Table 5 for performance on each item matched to the specific numbered area of the revised mathematics syllabus). The syllabus strands covered in this booklet include: 'expressions' (4.1), 'solving equations' (4.2), 'inequalities' (4.3), and 'complex numbers' 4.4). The items in this booklet were difficult for many students: out of the nine items, four had overall facilities under 20. The items with these low facilities were items 3, 5, 6 and 7. These four items each cover a different syllabus area, so there does not seem to be a link to topic area.

Item 6 assesses 'expressions' (4.1), and the facility was 16 per cent for this item. The other items assessing this have higher facilities: items 1a and b (facility 82 per cent and 25 per cent), and 2a (facility 1m: 8 2m: 76) and 2b (1m: 13 2m: 34). This suggests that it is question content that is proving difficult. Items 1 and 2 require students to substitute values and manipulate a single expression. In contrast, item 6 involves a composite function and asks students to determine its minimum value. It is therefore a more complex item, and as a result, the lower facility is not surprising.

Table 7.4: Item indicator booklet ALC4 (Algebra) – student performance and summary of items

Item	Syllabus area	Item summary	Phase One Students	
			1 mark (%)	2 marks (%)
1a	Expressions	Evaluate expression with four variables	82	
1b	Expressions	Construct expression to meet specified conditions	25	
2a	Equations	Solve equation with two variables given value of one	8	76
2b	Equations	Solve equation with two variables given value of one	13	34
3	Complex numbers	Divide real number by complex number (using complex conjugate)	13	
4	Inequalities	Solve inequality (quadratic)	26	
5	Inequalities	Solve inequality (algebraic fraction)	8	
6	Expressions	Find minimum value of composite function	16	
7	Equations	Form quadratic function given points of intersection with both axes	5	

Item 7 assesses ‘solving equations’ (4.2), and the facility was very low at 5 per cent. Item 7 is an open question which may have contributed to its lower facility, as other examples of open questions have shown generally weaker performance. However, there are no other items in the booklet covering the same syllabus area so it is unclear whether the low facility is particular to this type of item, or represents a wider lack of knowledge in this strand. This item requires students to form a quadratic function from its graph. The graph shows the points at which the function cuts both axes. While all students following the revised syllabus study quadratic equations, it may be that they are more familiar with solving equations to find the roots, rather than working backwards as this item requires.

Item 5, which assesses ‘inequalities’ (4.3), showed a facility of eight per cent. This area is also assessed by item 4, which had a higher facility of 26 per cent. Item 5 is open response, whereas item 4 is multiple choice and this may have contributed to the lower outcome for item 5. For item 4, it is possible that some students simply substituted in the values given in the multiple choice options and deduced the answer, rather than solving the inequality itself. This was not a possibility for item 5, as it is an open question. Furthermore, the inequality in item 5 contains an algebraic fraction, which requires students to square both sides before solving the inequality. It may be that some students were not aware of this necessary step.

Item 3, which assesses ‘complex numbers’ (4.4) showed a facility of 13 per cent. This item is a multiple choice question. Complex numbers are not covered on the Foundation Level syllabus, so not all students in the sample would be familiar with this topic. This item requires students to divide a real number by a complex number, and involves multiplying the numerator and denominator by the complex conjugate. It seems that only a small proportion of students were aware of this correct method. It may be the case that students are generally weak on this topic, but as this is the only item in the booklet that assesses this area, it is difficult to judge.

7.2.5 Strand 5: Functions

In the phase one schools, 180 students completed the Strand 5 booklet (FLC5). This booklet was based on Functions, and covered ‘functions’ (5.1) and ‘calculus’ (5.2) only. Table 7.5 below shows the performance of phase one students completing FLC5, as well as the broad syllabus area assessed, and a summary of the task (see Appendix A, Table 5 for performance on each item matched to the specific numbered area of the revised syllabus). This seemed to be a topic that students struggled with. The highest facility (item 3) was 77 per cent, although out of the 11 items, six showed facilities of under 20 per cent. All of these six items were based on syllabus area 5.2 (calculus), suggesting that this is an area that students may need to cover in more depth. It should be noted that calculus is not covered in the Foundation Level course, and integration in particular is only covered at the Higher Level. For this reason, additional analysis has been carried out to determine the item facilities of the different student level groups. Appendix A, Table 9 details the facilities of the Ordinary Level and Higher Level students on the seven items in FLC5 which assess a construct that

is only taught at the Higher Level. This includes five of the six items with facilities below 20 per cent. While the Higher Level students have performed better than their Ordinary Level counterparts, the facilities for four items remain below 20 per cent for both Ordinary and Higher Level groups, confirming that calculus is a topic that challenges students following the revised syllabus.

Of the six items with very low facilities, five of them are open response (there were five open response items in the assessment booklet in total). It is likely that students do not have sufficient understanding to cope with the extra demands of open response questions based on calculus. Omission rates were high on these open response questions, ranging from 33 per cent to 46 per cent. The percentage of students who omitted questions in booklet FLC5 was the highest overall omission rate of all the booklets. This also suggests relative unfamiliarity with this topic amongst students.

Table 7.5: Item indicator booklet FLC5 (Functions) – student performance and summary of items

Item	Syllabus area	Item summary	Phase One Students
			1 mark[20] (%)
1	Functions	Match story of phenomenon to graph (rising level of water in tank)	34
2	Calculus	Apply differentiation to find stopping distance of car	9
3	Functions	Match story of phenomenon to graph (height of feet above ground while swinging)	77
4a	Calculus	Find where function of order four cuts x-axis	2
4b	Calculus	Find maxima and minima of function (differentiate)	1
5	Calculus	Link slope of trigonometric function to its derivative	3
6	Functions	Find number of integer coordinates on graph of fractional function	21
7a	Calculus	Find values where function is not continuous (given graph)	15
7b	Calculus	Find values where function is not differentiable (given graph)	2
8	Calculus	Find value of definite integral (given area between function and x-axis)	28
9	Calculus	Integrate exponential function	24

[20] This booklet had no two mark items.

7.3 Comparison of student performance between phase one and non-phase one schools

Key messages

The performance of phase one and non-phase one students was broadly similar on Strands 1 and 2, which is to be expected, as both groups of students had been studying Strands 1 and 2 of the revised syllabus for the same amount of time.

Whilst there were some indications that phase one students performed better than their non-phase one peers in **analysing verbal geometric information and translating it into mathematical form**, in other items relating to this area there was no discernible difference between the two groups.

Tables 7.1 and 7.2 also present the scores of non-phase one students who completed booklets SPLC1 and GTLC2 (non-phase one students did not sit booklets NCL3, ALC4 or FLC5). This allows for a basic comparison of performance between phase one and non-phase one students. Appendix A, Table 5 presents further analysis of phase one and non-phase one students' performance, comparing their average scores on each item using the statistical analysis of differential item functioning.

7.3.1 Strand 1: Statistics and Probability

In the non-phase one schools, 725 students completed SPLC1. As shown in Appendix A, Table 5, performance of non-phase one students follows a similar pattern to that of phase one students with the same items found difficult or hard. Item 6, for example, continues to be the hardest item in the booklet with a facility of one per cent for both groups. Differences in facilities between individual items ranged from between zero to 11 percentage points. Seven out of a total of 10 items have a difference in facility of five percentage points or greater. In all cases, phase one students scored more highly than non-phase one students. These items are coloured orange in Table 5. However, the apparent difference in performance on individual items is likely to be due to sample differences as there is no significant difference between the phase one and non-phase one students for any of the items in the booklet.

7.3.2 Strand 2: Geometry and Trigonometry

In the non-phase one schools, 720 students completed GTLC2. Appendix A, Table 5 shows that, like SPLC1, the performance of non-phase one students follows a similar pattern to that of phase one students with the same items found difficult or hard. Those items where the percentage difference is five or more percentage points, and where phase one students achieved a higher performance than non-phase one students, are likewise highlighted in orange. The differences in facilities between phase one and non-phase one students ranged from zero to 11 percentage points. In

addition, phase one students performed significantly better than non-phase one students on item 1 (significance at the 1 per cent level). This item has the largest difference in facility (11 percentage points) between the two groups of students. This item assesses synthetic geometry (2.1), but also calls on students' 'synthesis and problems solving skills' (2.5). In particular, it requires students to analyse information presented verbally and translate it into mathematical form. This skill is not specific to this strand (Geometry and Trigonometry) and appears in the syllabus for all five strands of the revised syllabus. This sample of phase one students was studying four strands of the revised syllabus, while the non-phase one students were only studying two. It is possible that phase one students were more immersed in this aspect of the revised syllabus, leading to a higher performance on this type of item. That said, item 5 also requires the translation of verbal information into mathematical form and did not show differential performance. Thus, it is unclear whether the difference in performance on item 1 represents a systematic difference between phase one and non-phase one students.

There were three items in which performance of the non-phase one students was better than that of the phase one students by five or more percentage points. These were items 6, 9 and 10a and they have been highlighted in green in Table 5. The differences in percentage points for items 6 and 10a were seven and six respectively. However, only item 9 showed a statistically significant difference, indicating that the difference is less likely to be due to chance. The reason for this difference is unclear from the item content, as item 9 is very similar to item 7 which did not show differential performance. Both are open questions that assess 'coordinate geometry' and both require the use of a formula for the correct solution (the formulae for the slope and the midpoint of a line). As a result, these two items are very similar in demand. Given that there was no difference in performance on item 7, and that the difference was very small for item 9, there is not sufficient evidence to suggest a systematic difference in student proficiency in coordinate geometry.

7.3.3 Common Junior Certificate and Leaving Certificate items

Seven items/item parts were common to both the Junior Certificate item indicator booklet JC1/2 and either SPLC1 or GTLC2. The performance data for these items is drawn together in Tables 6 and 7 in Appendix A. Given the differences between the two samples in age and years of schooling it should be expected that higher facilities would be seen in the Leaving Certificate indicator item booklets. For phase one students, this is true of items 3, 4 and 7a in SPLC1, and also of items 2a and 3 in GTLC2. Item 7b of SPLC1 shows little difference in performance. It asks students to use the information presented in a graph to help them classify three statements as true or false. Although it requires a certain amount of reasoning, this is also true of item 3 (SPLC1) in which students must explain why a reporter's statement is or is not a reasonable interpretation of a graph. Item 4 of GTLC2 also shows little difference in performance between the Junior Certificate and Leaving Certificate students. It is not clear why this should be so as it is very similar in demand to items 2a and 3 in GTLC2.

Comparison of the results of the common items for non-phase one students shows a slightly different pattern. Leaving Certificate students performed better on items 3 and 4 in SPLC1 and all the items (2a, 3 and 4) in GTLC2. Both items 7a and 7b in SPLC1 show little difference in performance between the Junior Certificate and Leaving Certificate students. Item 7a was relatively easy for both groups, while item 7b was challenging for both. Item 7a involves a simple calculation of two mean scores and a comparison between them. This is a basic skill that is covered as early as primary school and is clearly grasped by the majority of students by that stage. Conversely, the second part of this item (7b) was challenging for both groups. It requires students to answer a series of true or false statements based on a graph. The graph is essentially a scatter plot but is presented similarly to a coordinate geometry grid. It is unclear why Leaving Certificate students found this item just as difficult as Junior Certificate students. It may be that this particular graph was an equally unfamiliar way of presenting information for both groups.

7.4 Comparison of student performance with international standards

Key messages

Phase one students performed much better than international students on many of the items relating to Strand 1 (Statistics and Probability) and Strand 2 (Geometry and Trigonometry), and the majority of these fall within Strand 1.

The high performance of phase one students on the items in this strand is encouraging and suggests that the **implementation of this part of the new syllabus is working well**. In general, phase one students performed better than expected on items where the solution strategy is clear, and where diagrams, if applicable, are provided. They performed less well on multi-step items.

The Leaving Certificate booklets were constructed using material from three international surveys: released items[21] from the Trends in International Mathematics and Science Study (TIMSS - 2007, 8th grade and TIMSS Advanced, 2008), and sample items[22] from the Programme for International Student Assessment (PISA) surveys of 2000, 2003, and 2006. International data is available for all TIMSS 2007 and TIMSS Advanced items, but not for PISA items, as these have not been used in a live test. As the performance of the phase one and non-phase one students was broadly similar, and the non-phase one students only completed two of the five booklets, the international data will only be compared with that of the phase one students.

[21] Released items are those that have been made public following administration of the survey, in contrast to secure items, which are kept secure for use in evaluating trends in performance in later cycles of TIMSS.
[22] Sample items exemplify the type of material included in a PISA assessment, but have not been used in a live test and so have no data available.

As with the Junior Certificate comparisons, a number of factors should be considered when comparing the performance of phase one students with performance internationally. For the TIMSS 2007 data, the primary caveats relate to age, stage of schooling and exam readiness. The TIMSS 2007 students were mostly 13 or 14 years of age, whereas most Leaving Certificate students are 17 or 18 years of age. While the TIMSS 2007 students were in 8th Grade (which equates to the second year of secondary school in Ireland), the phase one students tested in this evaluation were in their final year of secondary school (sixth year). The phase one students were also preparing for the Leaving Certificate examination, which is very high stakes (admission to tertiary education depends on their results). The combination of these factors places the phase one students at an advantage over the TIMSS 2007 students. For the TIMSS 2008 Advanced data, the situation is reversed. These students were of a similar age and stage of schooling as Leaving Certificate students. However, TIMSS Advanced collects data from students who have studied advanced mathematics in specialist tracked courses, with a view to further mathematics learning at tertiary level. These students represent only a subset of all secondary school students of that age. In contrast, the revised mathematics syllabus is compulsory for all Irish secondary school students. It is also designed to be inclusive and span a range of abilities (including Foundation, Ordinary and Higher Level). Therefore, we would not expect the average performance of phase one students to be quite as high as the international average in TIMSS Advanced.

Appendix A, Table 8 repeats the average scores of the phase one students (given in Table 5) and compares them to the international average scores in the 2007 TIMSS and 2008 TIMSS Advanced studies. This table informs the discussion below.

7.4.1 Strand 1: Statistics and Probability

Comparative data is available for three of the items in SPLC1: items 4, 7a and 7b. The remaining items were released PISA items and so, no international data is available. Table 7.6 below shows the number of items with differences in facility that fall within the three performance bands as described above.

Table 7.6: Number of items in SPLC1 showing facility differences in each performance band

Difference in facility between phase one and international students (percentage points)	Number of items with a score difference of 0-9 percentage points	Number of items with a score difference of 10-24 percentage points	Number of items with a score difference of ≥25 percentage points	Total
Phase one students score more highly	0	1	2	3
International students score more highly	0	0	0	0

All of these items were sourced from TIMSS Grade 8. Therefore, the advantages for phase one students in terms of age, stage of schooling and exam readiness apply here. Both phase one and non-phase one students performed well on this booklet. Phase one students also performed well relative to the international average; on two of the three items (items 4 and 7a) the difference in facilities was greater than 25 percentage points. Item 4 requires students to estimate the area of three coloured sectors on a spinner, given data on how many times the pointer stops in each sector. Apart from any differences in the characteristics of the student samples, the high performance on this item may be due to the focus in the revised mathematics syllabus on the 'outcomes of random processes'. This syllabus area (1.3) includes the principle of equally likely outcomes and specifies working with processes such as coins, dice and spinners.

Item 7a requires calculating two means from tabulated data. The data represents students' popularity ratings for two school subjects: mathematics and history. The item also requires students to judge which subject is more popular. The relatively higher performance of phase one students on this item is not surprising for two main reasons. Firstly, it has already been pointed out that students in the international sample were substantially younger and at an earlier stage in their schooling. Secondly, the syllabus area of 'representing data graphically and numerically' (1.6) places explicit emphasis on the use of measures of central tendency, including the mean. This is included in the syllabus from Foundation Level upwards, so all students should be familiar with this concept. The second part of this item (7b) requires students to interpret a graph where the ratings for each subject are plotted against each other. Students are asked to indicate whether each of three statements about the ratings is true or false. While the achievement of phase one students was higher than the international average, the difference was not as large as for the other items in this strand. The relatively poorer performance on this item may be due to the graph used. The ratings were plotted in the style usually used in coordinate geometry. This may have been unfamiliar to students in a data interpretation context. In addition, as

discussed earlier in this report, coordinate geometry is an area that the Leaving Certificate sample found difficult.

7.4.2 Strand 2: Geometry and Trigonometry

Comparative data is available for nine of the 13 items/item parts in GTLC2. Table 7.7 below shows the number of items with differences in facility that fall within the three performance bands.

Table 7.7: Number of items in GTLC2 showing facility differences in each performance band

Difference in facility between phase one and international students (percentage points)	Number of items with a score difference of 0-9 percentage points	Number of items with a score difference of 10-24 percentage points	Number of items with a score difference of ≥25 percentage points	Total
Phase one students score more highly	0	1	2	3
International students score more highly	3	2	1	6

As Table 7.7 shows, phase one students performed above the international average on three items (2a, 3 and 4). These items were sourced from the TIMSS Grade 8 survey, and all assess the syllabus area of synthetic geometry (2.1). Given the advantages of phase one students over the international sample in terms of age and experience, these differences are to be expected. The pattern is very different for the remaining items, which were taken from the 2008 TIMSS Advanced survey. On item 5 in particular, there was a large difference in facility of 40 percentage points in favour of the international sample. This item also assesses synthetic geometry but includes the concept of a median of a triangle. While this term is included in the revised mathematics syllabus, it is possible that some students failed to recall its meaning. In addition, this item gave a verbal description and did not include a diagram. It may be that phase one students are less proficient at visualising a geometric situation than their international peers.

Items 6, 7 and 9 assess coordinate geometry. For items 7 and 9, performance was very similar to the international average with differences of 7 per cent. Both of these items provide a diagram and can be solved by using a formula (for the midpoint and the slope of a line). In contrast, for item 6, the difference in facility was 20 percentage points in favour of the international students. For this item there is no diagram and the solution strategy is less clear. It requires students to apply their knowledge of slopes to a triangle. It is possible that not all students following the revised syllabus are achieving the aim of applying knowledge to unfamiliar and less procedural problems. Items 8a and 10 assess trigonometry.

For item 8a, performance was very similar among phase one students and international sample. However, performance was somewhat different on item 10a, with a difference in achievement of 14 per cent in favour of the international students. This item required a number of steps to find the solution. It may be that phase one students are less able to handle multi-step problems than their counterparts internationally.

7.4.3 Strand 3: Number

Comparative data are available for three of the items/item parts in NLC3. All three were taken from TIMSS Advanced and assess 'number systems' (3.1). Table 7.8 below shows the number of items with differences in facility that fall within the three performance bands.

Table 7.8: Number of items in NLC3 showing facility differences in each performance band

Difference in facility between phase one and international students (percentage points)	Number of items with a score difference of 0-9 percentage points	Number of items with a score difference of 10-24 percentage points	Number of items with a score difference of ≥25 percentage points	Total
Phase one students score more highly	0	0	0	0
International students score more highly	1	2	0	3

Item 10 requires students to describe, but not perform, the steps needed for proof by induction. The difference in facility for this item was relatively small (9 percentage points) and could be due to sampling error. For items 6 and 7 there were moderate differences in facility, favouring the international average (16 per cent and 21 per cent). Item 6 requires students to interpret verbal information and translate it into mathematical form. While this skill is explicitly addressed in the revised syllabus, phase one students do not appear to be demonstrating this as well as the TIMSS Advanced students. Item 7 requires students to find the sum of an infinite geometric series.

7.4.4 Strand 4: Algebra

Comparative data are available for five of the seven items in ALC4. All of these items were sourced from TIMSS Advanced 2008. Table 7.9 shows the number of items with differences in facility that fall within the three performance bands.

Table 7.9: Number of items in ALC4 showing facility differences in each performance band

Difference in facility between phase one and international students (percentage points)	Number of items with a score difference of 0-9 percentage points	Number of items with a score difference of 10-24 percentage points	Number of items with a score difference of ≥25 percentage points	Total
Phase one students score more highly	0	0	0	0
International students score more highly	1	3	1	5

As Table 7.9 shows, the performance of phase one students was mixed in comparison with the international sample. For item 3, performance was very similar, with both samples finding it difficult. This item involves dividing a real number by a complex number. However, the performance of phase one students on this item is perhaps better than expected, as complex numbers are not part of the revised syllabus at Foundation Level. Items 4, 6 and 7 displayed a moderately higher facility for international students, which is the expected finding. Item 6 requires students to simplify an expression consisting of a composite function, and determine its minimum value. Item 7 assesses students' understanding of the link between the graphical and numerical form of a quadratic function. The solution strategies required for this item are not covered at Foundation Level, and this may have contributed to the lower average performance among phase one students. Item 4 requires students to solve a quadratic inequality. However, because this was a multiple choice item, students could also have substituted in the values given in the response options and deduced the answer. The only item that displayed a much higher facility for the international sample was item 5.

7.4.5 Strand 5: Functions

Comparative data are available for nine of the items/item parts of FLC5. All of these items were sourced from TIMSS Advanced 2008. As discussed earlier in this report, Irish students found this booklet particularly difficult. On many items, their performance was also poor compared with the international average. Table 7.10 shows the number of items with differences in facility that fall within the three performance bands.

Table 7.10: Number of items in FLC5 showing facility differences in each performance band

Difference in facility between phase one and international students (percentage points)	Number of items with a score difference of 0-9 percentage points	Number of items with a score difference of 10-24 percentage points	Number of items with a score difference of ≥25 percentage points	Total
Phase one students score more highly	0	0	0	0
International students score more highly	2	3	4	9

As Table 7.10 shows, phase one students did not outperform the international sample on any item. However, given the characteristics of the TIMSS Advanced students mentioned earlier, this would not necessarily be expected. For items 8 and 9, the difference in facility was only 7 per cent. Both of these were calculus items involving integration (5.2). This similar performance is noteworthy here, as integration is only covered at Higher Level in the revised syllabus. Therefore, only a subset of the phase one students would have been familiar with this concept. Additional analysis for items 8 and 9 (Appendix A, Table 9) confirms that the performance of the Higher Level students is similar to or better than that of the international students who scored two percentage points higher and 10 percentage points lower for these items respectively. The remaining calculus items (2, 4, 5 and 7) displayed moderate to large differences in facilities. In particular, calculus performance was very different for items 4a, 5 and 7a. Item 4a requires students to find the roots of a function of order four. It may be that phase one students are more comfortable with functions of order two and three. One of the solution strategies for item 5 involves differentiating a trigonometric function, a skill which is only included in the Higher Level syllabus. Item 7a asks students to indicate the values for which a function is continuous. It is possible that phase one students were not as familiar with this terminology as the TIMSS Advanced students. Because the construct for items 4, 5 and 7 is contained in the syllabus for the Higher Lever only, additional analysis has been carried out to calculate the facilities of the Higher Level students on these items. Appendix A, Table 9 confirms that the Higher Level students found these items more difficult than the international students.

Item 6 also showed a large difference in facility in favour of the international sample. This item assesses functions, and requires students to deduce the number of integer coordinates on the graph of a function. However, the graph is not provided. As in Strand 2 (Geometry and Trigonometry), this suggests a weakness among Irish students in visualising or constructing graphical representations of verbal information, compared with students of a similar age internationally.

8. Leaving Certificate student attitude survey

This chapter presents the findings of the first survey of Leaving Certificate students' attitudes towards mathematics, for both phase one and comparison group schools. It explores:

- their experiences of mathematics lessons
- their attitudes towards learning mathematics
- their views and perspectives on careers involving mathematics.

Key messages are highlighted in each of these sections, and in relation to individual strands of the revised syllabus.

8.1 Students' experiences of mathematics lessons

Following the same approach taken within the Junior Certificate survey, Leaving Certificate students were asked about how mathematics is taught in school in order to compare the learning experiences of phase one students with the non-phase one group. The areas explored echoed those of the Junior Certificate survey, detailed in section 5.1. An overview of Leaving Certificate students' perspectives in relation to each of these areas is presented in Figure 8.1. Phase one students are presented alongside those of the comparison group so that similarities and differences are immediately apparent.

Figure 8.1: Proportion of Leaving Certificate students reporting that they 'often' or 'sometimes' take part in mathematics teaching and learning activities

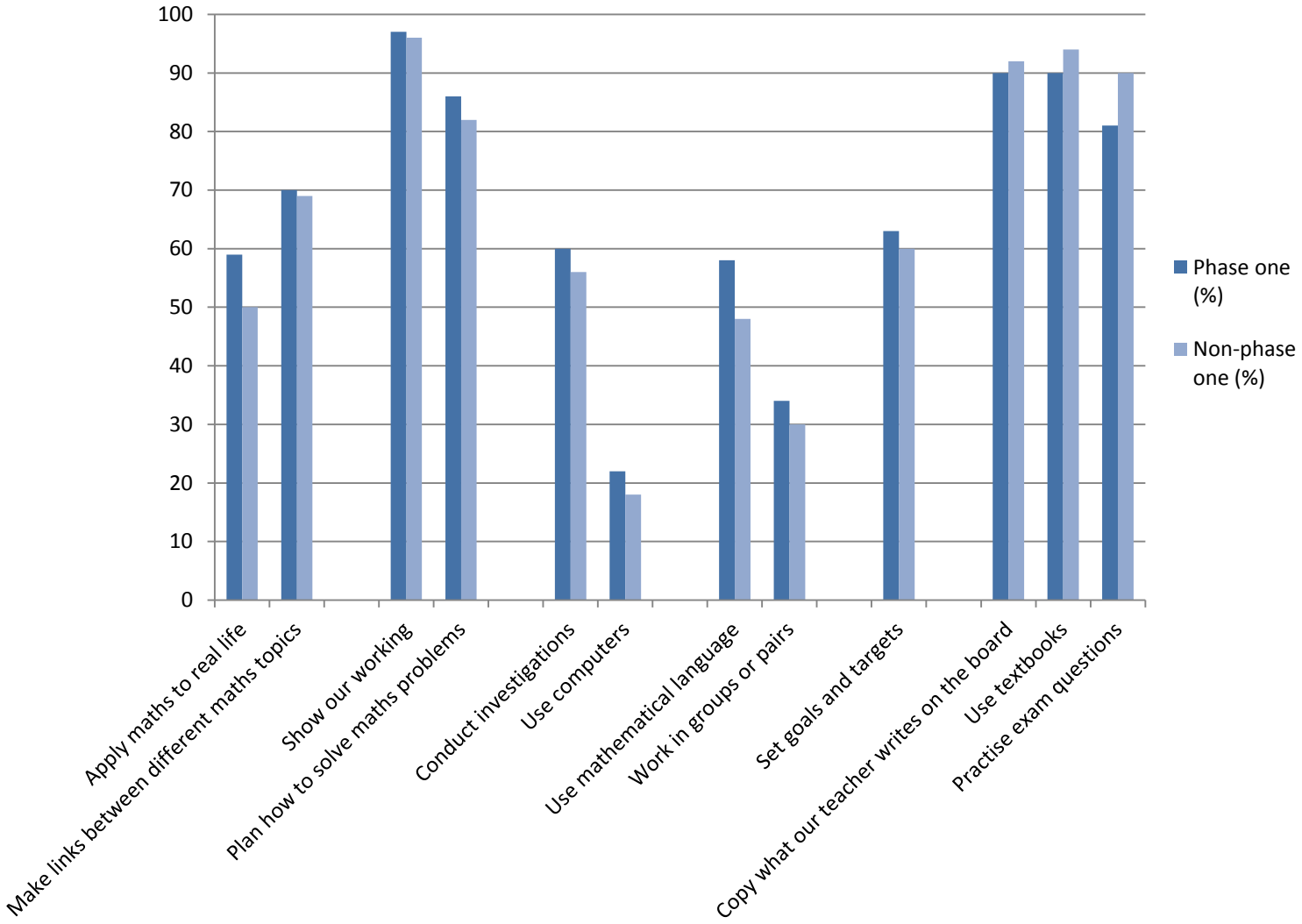

Figure 8.1 shows that Leaving Certificate students gave a similar pattern of responses as their Junior Certificate peers, with a higher proportion of phase one students reporting positive responses in many of the areas promoted by the revised syllabus.

8.1.1 Students' perspectives on learning approaches characteristic of the revised syllabus

This section explores students' perspectives on the learning approaches they have experienced in their mathematics lessons.

Applying mathematics

Key messages

Leaving Certificate students following all strands of the revised syllabus reported particularly strongly, relative to those who were just studying Strands 1-2, they that **regularly applied their learning to real-life situations**. Likewise, whilst high proportions of both groups 'sometimes' make **connections between different mathematics topics**, a higher proportion of phase one students do this 'often'. This suggests that the approaches promoted through the revised syllabus become increasingly apparent as students become more immersed.

Overall, both groups of students reported that they regularly **apply what they learn in mathematics to real-life situations less frequently than the Junior Certificate students**, indicating that this approach may not be as well established at Leaving Certificate level.

Similar to the responses given by Junior Certificate students, phase one students at Leaving Certificate reported particularly strongly, relative to their non-phase one peers, they that regularly **applied their learning** to real-life situations and to other mathematics topics.

The Leaving Certificate survey showed, for example, that there were statistically significant differences between the frequency with which students **applied their learning in mathematics to real-life situations** between phase one and non-phase one groups. The findings are presented in Table 8.1:

Table 8.1: We apply what we learn in maths to real life situations

	Phase one %	Non-phase one %
Often	21	11
Sometimes	38	39
Rarely	31	36
Never	9	13
No response	0	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 299 phase one students, and 1,991 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 8.1 shows that just under three-fifths of phase one students (59 per cent) reported that they apply their learning to real-life situations 'sometimes' (38 per cent) or 'often' (21 per cent). By contrast, half (50 per cent) of the non-phase one group reported that they do this 'sometimes' (39 per cent) or 'often' (11 per cent).

This demonstrates that a higher proportion of phase one students, relative to the non-phase one group, regularly apply their learning in mathematics to real-life contexts, indicating that such approaches are being implemented at Leaving Certificate, as well as Junior Certificate, levels. The absolute difference between the two groups is less pronounced that at Junior Certificate level, which is perhaps to be expected as non-phase one students have themselves studied part of the revised syllabus. This is indicative that the frequency with which students make use of real-life contexts in their mathematics increases with the number of strands studied. This suggests that the use of such contexts is being applied consistently across all strands of the revised syllabus.

However, it should also be noted that, overall, both phase one and non-phase one groups reported that they regularly apply what they learn in mathematics to real-life situations less frequently than the Junior Certificate groups, indicating that this approach is not as embedded at Leaving Certificate level. Indeed, a substantial minority of phase one students (40 per cent) also reported that they 'rarely' (31 per cent) or 'never' (nine per cent) apply what they learn in mathematics to real-life situations. This suggests that, despite the positive findings indicated above, there remains room for development in this area.

Similarly, as shown in Table 8.2, when asked how frequently they **made links between different mathematics topics**, there was a statistically significant difference between the responses of phase one and non-phase one students.

Table 8.2: We make links between different maths topics

	Phase one %	Non-phase one %
Often	31	23
Sometimes	39	46
Rarely	20	20
Never	9	9
No response	1	2
Total	100	100

Due to rounding percentages may not sum to 100

A total of 299 phase one students, and 1,991 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 8.2 shows that, like the Junior Certificate survey, whilst broadly similar proportions of Leaving Certificate students in phase one and non-phase one schools 'sometimes' make connections between mathematics topics (39 per cent of phase one, and 46 per cent of non-phase one students), a higher proportion of phase one students do this 'often' (31 per cent of phase one, and 23 per cent of non-phase one students). This is perhaps to be expected as phase one students, having studied a greater number of revised syllabus strands, have a wider range of syllabus topics to link together, and therefore potentially greater opportunities to do this. Nonetheless, it is an encouraging indication that such approaches are being effectively translated into classroom practice.

Knowledge of the processes underpinning mathematics

Key messages

The findings suggest that **Leaving Certificate students following the revised syllabus are being encouraged to consider the 'how' and the 'why' of mathematics in lessons**, and that this increases with the number of syllabus strands studied. For example, a higher proportion of Leaving Certificate students following all strands of the revised syllabus, relative to those following Strands 1-2 of the syllabus, reported that they regularly **think about mathematics problems and plan how to solve them in lessons**, although the majority of both groups reported that they did this 'sometimes' or 'often'.

Interestingly, the vast majority of both groups of Leaving Certificate students reported that they regularly **show their working to justify their answers**. However, assessment of student achievement suggested that students did not show routinely their working, indicating that **there may be some discrepancies between students' attitudes and abilities in this area**.

Figure 8.1 shows that Leaving Certificate students in both phase one and non-phase one groups had, more strongly than any other aspect of the revised syllabus, regularly participated in teaching and learning activities aiming to develop their knowledge of **the processes underpinning mathematics**. In some areas, the experiences of phase one and non-phase students appeared to be similar: there was, for example, no statistically significant difference in the frequency with which phase one and non-phase one students **show their working to justify their answers** (97 per cent of phase one students, and 96 per cent of comparison group students reported that they do this 'sometimes' or 'often') (Appendix B, Table 40).

However, as shown in Table 8.3, a higher proportion of phase one Leaving Certificate students, relative to the non-phase one group, reported that they regularly **think about mathematics problems and plan how to solve them** in lessons.

Table 8.3: We think about maths problems and plan how to solve them

	Phase one %	Non-phase one %
Often	54	46
Sometimes	32	36
Rarely	8	13
Never	5	3
No response	1	2
Total	100	100

Due to rounding percentages may not sum to 100

A total of 299 phase one students, and 1,991 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 8.3 shows that the vast majority (86 per cent) of phase one students reported that they do this 'sometimes' (32 per cent) or 'often' (54 per cent). By comparison, 82 per cent of non-phase one group students reported that they do this 'sometimes' (36 per cent) or 'often' (46 per cent). This is a statistically significant difference, which indicates that the revised syllabus has positively impacted on students' learning experiences in this area. Again, this finding indicates both that students are being encouraged to consider the 'how' and the 'why' of mathematics lessons, and that the extent to which students take part in this type of activity increases according to the number of revised syllabus strands studied.

Participation in investigative, practical activities

Key messages

The findings suggest that the **frequency with which Leaving Certificate students participate in investigative, practical activities increases with the number of revised syllabus strands studied**, reflecting the importance placed on these approaches within the revised syllabus. For example, Leaving Certificate students following all strands of the revised syllabus appear to conduct investigations to solve mathematics problems more frequently than those following Strands 1-2 (although the majority of both groups reported that they did so regularly).

Although Leaving Certificate students following all strands reported that they regularly used computers in mathematics to help them solve problems more frequently than those following Strands 1-2, a high proportion of both groups reported that they 'rarely' or 'never' do this. Use of IT in mathematics lessons may, therefore, be an area for further development.

Figure 8.1 tells us that, like the Junior Certificate students, a higher proportion of phase one students studying for their Leaving Certificate regularly take part in investigations and practical activities in mathematics, than their comparison group peers. Again, however, there was considerable variation in the extent to which this appears to be occurring.

The findings show that there was a statistically significant difference between phase one and non-phase one students, in terms of the frequency with which they **conduct investigations to solve mathematics problems,** with phase one students tending to undertake investigations more frequently than their non-phase one peers. The findings are presented in Table 8.4:

Table 8.4: We do investigations to solve maths problems

	Phase one %	Non-phase one %
Often	29	21
Sometimes	31	35
Rarely	28	28
Never	10	15
No response	1	2
Total	100	100

Due to rounding percentages may not sum to 100

A total of 299 phase one students, and 1,991 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012

Table 8.4 shows that the majority of students in the phase one group (60 per cent) reported that they conduct investigations to solve mathematical problems 'sometimes' (31 per cent) or 'often' (29 per cent). By contrast, this was reported by 56 per cent of non-phase one students: of whom, a slightly higher proportion reported that they did this 'sometimes' (35 per cent), and a slightly smaller proportion reported that they did this 'often' (21 per cent). Again, this finding reflects the high degree of emphasis placed on investigative, problem-solving approaches in the revised syllabus, and demonstrates that the frequency with which students participate in such activities appears to be increasing with the number of revised syllabus strands studied.

Similar to the findings of the Junior Certificate survey, use of information technology (IT) in the classroom as a tool for teaching mathematics was, at Leaving Certificate level, more limited. As shown in Table 8.5, although phase one students were more likely than non-phase one to **use computers in mathematics to help them solve problems** on a regular basis, a high proportion of both groups reported that they 'rarely' or 'never' do this (77 per cent of phase one students reported that this was the case, with 55 per cent reporting 'never', compared to 81 per cent of non-phase one students, with 62 per cent reporting 'never').

Table 8.5: We use computers in maths lessons to help us solve problems

	Phase one %	Non-phase one %
Often	4	5
Sometimes	18	13
Rarely	22	19
Never	55	62
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 299 phase one students, and 1,991 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

These are statistically significant differences and, as with the Junior Certificate survey, suggest that whilst it is encouraging that use of IT appears to be increasing with the number of strands studied, there may be room for further development. More promisingly, however, use of computers in mathematics appears to have increased between Junior and Leaving Certificate levels, indicating that there is scope for schools to increase the range of ways that they use IT in mathematics lessons. This suggests that use of IT may continue to rise as schools become increasingly familiar with its application in the revised syllabus.

Participation in discursive and collaborative activities

Key messages

Over half of both groups of Leaving Certificate students reported that they regularly **talk about their ideas using the language of mathematics** in lessons. However, a greater proportion of students studying all strands of the revised syllabus appeared to do so regularly. Again, this suggests that the level at which students engage in discursive, collaborative and investigative activities increases according to the number of revised syllabus strands studied.

Relatively few Leaving Certificate students regularly work together in small groups or pairs, although again a greater proportion of students following all strands appear to do this regularly. This suggests that such activities are increasing as the revised syllabuses become further embedded within schools

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Figure 8.1 also shows that, like the Junior Certificate survey, there are differences in the frequency with which students participate in different types of discursive and collaborative activities. As shown in Table 8.6, for example, phase one students reported that they **talk about their ideas using the language of mathematics** in lessons more frequently than non-phase one students.

Table 8.6: We talk about our ideas using the language of maths

	Phase one %	Non-phase one %
Often	22	15
Sometimes	36	33
Rarely	24	31
Never	16	20
No response	1	2
Total	100	100

Due to rounding percentages may not sum to 100

A total of 299 phase one students, and 1,991 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012

Table 8.6 shows that just under three-fifths (58 per cent) of phase one students talk about their ideas using the language of mathematics 'sometimes' (36 per cent) or 'often' (22 per cent), compared to just under half (48 per cent) of non-phase one students who reported that they do this 'sometimes' (33 per cent) or 'often' (15 per cent). This difference is statistically significant, and demonstrates that a higher proportion of phase one students, relative to the non-phase one group, feel that they regularly use mathematical language to convey their ideas. This suggests that the level at which students engage in discursive, collaborative and investigative activities increases according to the number of revised syllabus strands studied. This, in conjunction with the findings from the Junior Certificate survey, affirms that such techniques are being readily and continuously applied in the classroom.

By contrast, a far lower proportion of Leaving Certificate students in both phase one and non-phase one groups reported that they regularly **work together in small groups or pairs**, relative to other areas. The findings are presented in Table 8.7:

Table 8.7: We work together in small groups or pairs

	Phase one %	Non-phase one %
Often	12	8
Sometimes	22	22
Rarely	36	32
Never	29	37
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 299 phase one students, and 1,991 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

However, Table 8.7 shows that relatively few students regularly work together in small groups or pairs, although phase one students appear to do this more frequently than their non-phase one peers. Whilst overall, 65 per cent of phase one students, and 69 per cent of non-phase one students, reported that they do not regularly work in this way, a greater proportion of non-phase one students reported that they 'never' do this (29 per cent of phase one students, and 37 per cent of non-phase one students reported that this was the case),

This finding is statistically significant, and suggests that classroom activities which involve working in groups or pairs are relatively uncommon at Leaving Certificate level. However, the fact that this happens more frequently in phase one than non-phase one schools suggests that such activities are increasing as the revised syllabuses become further embedded within schools. This may, therefore, lead to a general increase in pair and group work over time.

Becoming active learners

Key messages

The majority of Leaving Certificate students reported that they **regularly set goals and targets about their mathematics learning**, and the degree to which this occurred was similar between the two groups. It is encouraging that aspect of the revised syllabus appears to have been applied in the classroom.

The majority of both phase one and non-phase students reported that they frequently **set goals and targets about their mathematics learning** (63 per cent of phase one

students, and 60 per cent of comparison group students reported that they do this 'sometimes' or 'often') (Appendix B, Table 41). Whilst it is encouraging that high proportions of both phase one and non-phase one students routinely use these approaches, as with the Junior Certificate group this is not a statistically significant difference. This indicates that the revised syllabus has not yet had an impact in relation to this particular approach.

8.1.2 Students' perspectives on learning approaches characteristic of a more traditional syllabus

Key messages

Whilst there are many positive indications that the approaches promoted through the revised syllabus are being reflected in the classroom, **there remains a high proportion of phase one pupils who report that they participate in activities associated with more traditional approaches to mathematics teaching and learning** (for example, using textbooks in lessons and copying from the board).

Unlike Junior Certificate students, however, in general **Leaving Certificate students studying all strands of the revised syllabus appeared to be participating in these types of activities less frequently** than those studying Strands 1-2. This is an encouraging finding, as it suggests that such approaches are becoming less common as the revised syllabus is increasingly embedded within schools.

Again following a similar pattern to the Junior Certificate survey, Figure 8.1 shows that although there are positive indications that the approaches promoted through the revised syllabus are being reflected in the classroom, there remains a high proportion of phase one pupils who report that they participate in activities associated with more traditional approaches to mathematics teaching and learning.

Unlike Junior Certificate students, phase one Leaving Certificate students were statistically less likely to **copy what their teacher writes on the board then practise using examples** than their non-phase one peers. The findings are presented in Table 8.8:

Table 8.8: We copy what our teacher writes on the board then practise using examples

	Phase one %	Non-phase one %
Often	69	70
Sometimes	20	22
Rarely	6	6
Never	4	1
No response	2	2
Total	100	100

Due to rounding percentages may not sum to 100

A total of 299 phase one students, and 1,991 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 8.8 shows that overall, 89 per cent of the phase one group reported that they did this 'sometimes' (20 per cent) or 'often' (69 per cent), compared to 92 per cent of the non-phase one group who reported that they did this 'sometimes' (22 per cent) or 'often' (70 per cent). Whilst it is encouraging that the frequency with which students undertake this type of activity reduces with the number of revised syllabus strands studied, the overall proportion of both groups reporting that they do this regularly remains high. Additionally, a greater proportion of phase one Leaving Certificate students report that they do this 'often' compared to their Junior Certificate counterparts.

A lower proportion of phase one Leaving Certificate students also reported that they **use textbooks in lessons and then practise what they have learned, either in class or for homework**, than their non-phase one peers. The findings are presented in Table 8.9:

Table 8.9: We use text books in lessons then practise what we have learned in class and/or for homework

	Phase one	Non-phase one
	%	%
Often	75	80
Sometimes	15	14
Rarely	5	4
Never	4	2
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 299 phase one students, and 1,991 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 4.14 shows that:

- a total of 90 per cent of phase one students reported that they use text books in lessons then practise what they have learned in class or for homework 'sometimes' (15 per cent) or 'often' (75 per cent)
- by contrast, 94 per cent of non-phase one students reported that they do this 'sometimes' (14 per cent) or 'often' (80 per cent).

This is a statistically significant difference, and suggests that whilst those students studying a greater number of revised syllabus strands are using textbooks less frequently than those following a mixed syllabus, use of textbooks amongst phase one students remains high. Furthermore, phase one students at Leaving Certificate appear to be using textbooks considerably more often than their Junior Certificate phase one peers, despite studying an additional strand of the revised syllabus. It may, therefore, be valuable to explore ways of supporting schools to develop more varied approaches in this area.

Similarly, a lower proportion of phase one students, relative to the comparison group, reported that they regularly **practise examination questions in class**. The findings are presented in Table 8.10:

Table 8.10: We practise exam questions in class

	Phase one %	Non-phase one %
Often	49	71
Sometimes	32	19
Rarely	12	6
Never	6	3
No response	0	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 299 phase one students, and 1,991 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 8.10 shows that the vast majority (81 per cent) of phase one students reported that they did this 'sometimes' (32 per cent) or 'often' (49 per cent), compared to 90 per cent of comparison group students who reported that they did this 'sometimes' (19 per cent) or 'often' (71 per cent). This is a statistically significant difference, and suggests that the extent to which students' practise examination questions in class reduces as the number of revised syllabus strands increases. This may, in part, be because there are fewer examination papers relating to the revised syllabus currently available, but is a positive indicator that schools are using a wider range of techniques to prepare their students for examinations, rather than relying on practice papers.

8.1.3 Students' perspectives on mathematics teaching

Key messages

Leaving Certificate students in both groups were **highly positive about their experiences of mathematics teaching**, suggesting that their teachers were able to help and support them effectively. This is a positive indicator of the success of the teaching approaches promoted through the revised syllabus.

Students were also asked about how their teachers were helping and supporting them in their mathematics classes, as an indicator of their experiences of the teaching approaches promoted throughout the revised syllabus. Leaving Certificate students, in both phase one and non-phase one schools, and similar to their Junior Certificate peers, were highly positive about the mathematics teaching they had experienced.

The only statistically significant difference between phase one and non-phase one students related to the extent of their agreement that their teacher **is easy to understand**, as shown in Table 8.11:

Table 8.11: My teacher is easy to understand

	Phase one %	Non-phase one %
Agree a lot	49	53
Agree a little	29	29
Disagree a little	14	11
Disagree a lot	7	6
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 299 phase one students, and 2,004 comparison group students, gave at least one response to these questions.
Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 8.11 shows that:

- the vast majority (81 per cent) of phase one students agreed either 'a little' (38 per cent) or 'a lot' (43 per cent) that their teacher is easy to understand
- a slightly greater proportion (84 per cent) of non-phase one students agreed either 'a little' (32 per cent) or 'a lot' (52 per cent) that their teacher is easy to understand
- whilst, overall, both groups of students had positive views in this area, phase one students found it more challenging to understand their teachers than non-phase one students. This could, perhaps, be attributable to the challenges facing teachers in teaching all five strands of the revised syllabus for the first time.

In other areas, no statistically significant differences were found between students in phase one and non-phase one schools (Appendix B, Tables 42-48), including in relation to the extent which students felt their teacher sets them work to suit their abilities and interests (which was found to be significant at Junior Certificate level).

8.1.4 Discussion

Again, this section identifies many interesting findings arising from the research, and largely affirms that students have had similar experiences of mathematics lessons at Junior Certificate and Leaving Certificate levels. Additionally, the Leaving Certificate findings show that the positive impacts on students' experiences appear, in many cases, to increase with the number of strands studied. This suggests that the approaches to mathematics promoted throughout the mathematics syllabuses will continue to grow and develop as they become more embedded within schools.

In subsequent stages of the research, it will be valuable to explore further the benefits and challenges of providing students with this type of learning experience. For example, whilst there are positive differences in the extent to which phase one and non-phase one students participate in more traditional teaching and learning approaches, for example practising for examinations, suggesting that this becomes less frequent in time, it remains a fairly prominent feature of students' experiences. Possible areas for further investigation include, then, consideration of why this is the case.

8.2 Students' attitudes towards learning mathematics

This section explores Leaving Certificate students' attitudes towards learning mathematics, both generally and in relation to the individual strands of the revised syllabus.

8.2.1 Attitudes towards individual strands of the revised mathematics syllabus

Students were asked about how confident they would feel when undertaking a range of different activities during their mathematics lessons, to gain a further insight into their attitudes towards specific areas pertinent to the revised syllabus. Leaving Certificate students were asked about the same aspects of individual strands as their Junior Certificate counterparts, as detailed in section 5.2.

An overview of students' perspectives in relation to each of these areas is presented in Figure 8.2:

Figure 8.2: Proportion of Leaving Certificate students reporting that they would find it 'very easy' or 'easy' if they were asked to solve problems in each of the following areas

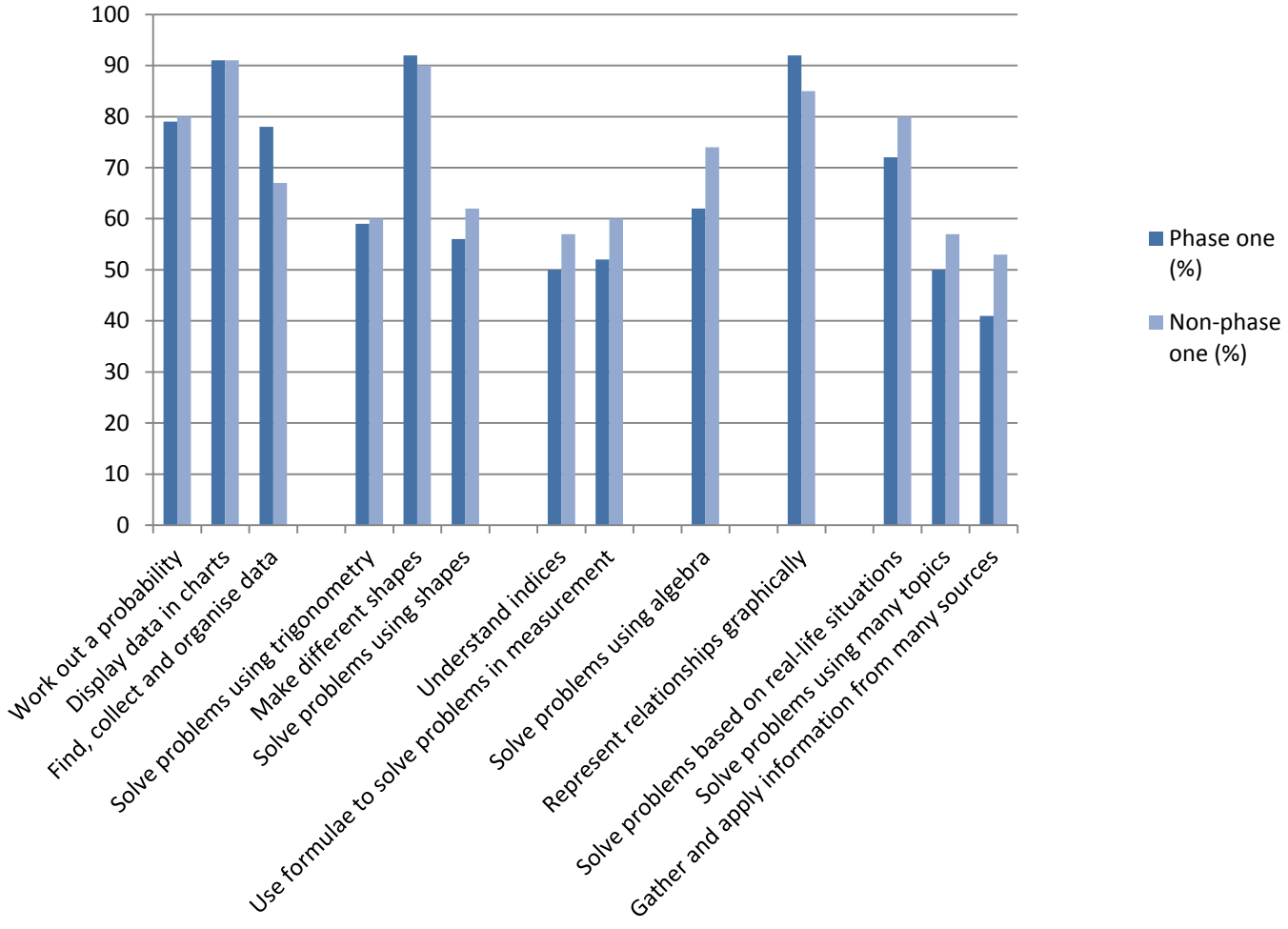

Figure 8.2 shows that both phase one and comparison group students are broadly confident in their abilities in topics spanning all strands of the revised syllabus, although, as with the Junior Certificate survey, there is considerable variation both within and between individual strands. This is explored more fully in the following sections.

8.2.2 Strand 1: Statistics and Probability

Key messages

Both groups of Leaving Certificate students appeared to be highly confident in items relating to Strand 1, Statistics and Probability. Overall, the vast majority of students in both groups reported that they would be **confident to calculate the probability of an event occurring**, and **to display their data using charts, including pie charts and bar charts**. The similarity between the two groups is perhaps to be expected, given that both groups of students have studied this strand of the revised syllabus, and it is encouraging that such high proportions of students feel confident to undertake these types of activities.

Students following all strands of the revised syllabus appeared to feel somewhat more confident, however, than those following Strands 1-2 at **finding, collecting and organising data**, although again responses were highly positive amongst students in both groups.

Students were asked how confident they would feel in working out the probability of an event occurring. Overall, the vast majority of students in both groups (79 per cent of phase one students and 80 per cent of non-phase one students) reported that they would find it 'easy' or 'very easy' to calculate the probability of an event occurring and there was no statistically significant difference between the two (Appendix B, Table 49).

Equally, there was no statistically significant difference between the different groups of students in relation to their confidence to **display their data using charts, including pie charts and bar charts** (91 per cent of both phase one and non-phase one students reported that they would find this 'easy' or 'very easy'). These findings are perhaps to be expected, given that both groups of students have studied this strand of the revised syllabus, and it is encouraging that such high proportions of both phase one and non-phase one students feel confident to undertake these types of activities (Appendix B, Table 50).

There was, however, a statistically significant difference between the two groups in terms of their confidence to **find, collect and organise data** (for example, to time each person in their class while they estimated the length of minute and subsequently organise their answers into sequence order). However, both groups provided positive responses. The findings are presented in Table 8.13.

Table 8.13: If I were asked to find, collect and organise data…

	Phase one %	Non-phase one %
I would find it very easy	34	29
I would find it easy	44	38
I would find it a little difficult	16	26
I would find it very difficult	4	5
No response	2	2
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 299 phase one students, and 2,004 comparison group students, gave at least one response to these questions.
Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 8.13 shows that:

- phase one students appeared to feel somewhat more confident than their non-phase one peers at finding, collecting and organising data
- over three-quarters (78 per cent) of phase one students reported that they would find this 'easy' (44 per cent) or 'very easy' (34 per cent)
- by contrast just over two-thirds (67 per cent) of non-phase one students reported that they would find this 'easy' (38 per cent) or 'very easy' (29 per cent).

8.2.3 Strand 2: Geometry and Trigonometry

Key messages

Overall, Leaving Certificate students in both groups were confident in their responses to items relating to Strand 2. Like Junior Certificate students, however, Leaving Certificate students in both groups appeared to be slightly less confident in this strand than they were in items relating to Strand 1.

The majority of students in both groups reported that they would be confident in **solving problems using trigonometry**. Students following all strands of the syllabus, however, appeared to be slightly more confident than those following Strands 1-2, in their use of shape. Given that both groups of students had studied this strand, this indicates that students may feel more confident within individual strands of the revised syllabus when they are following a greater number of strands overall.

In general, Leaving Certificate students in both phase one and non-phase one groups were, like Junior Certificate students, less confident in relation to Strand 2 of the revised mathematics syllabus than they were in relation to Strand 1.

When students were asked how confident they would feel to **solve problems using trigonometry**, around three-fifths of both phase one and non-phase one students (59 per cent, and 60 per cent, respectively) reported that they would find this 'easy' or 'very easy'. Again, this is perhaps to be expected, given that both groups of students have studied this strand of the revised syllabus (Appendix B, Table 51).

There was, however, a statistically significant difference between phase one and non-phase one groups when asked how confident they would feel to **make different shapes** (for example, to draw a triangle with sides of length 3cm, 5cm and 8cm). The findings are presented in Table 8.14:

Table 8.14: If I were asked to make different shapes...

	Phase one %	Non-phase one %
I would find it very easy	66	64
I would find it easy	27	26
I would find it a little difficult	4	7
I would find it very difficult	0	2
No response	2	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 299 phase one students, and 2,004 comparison group students, gave at least one response to these questions.
Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 8.14 shows that:

- both phase one and non-phase one students were highly confident at making different shapes, although phase one students were more confident than their non-phase one peers
- 93 per cent of phase one students reported that they would find this 'easy' (27 per cent) or 'very easy' (66 per cent)
- by contrast, 90 per cent of non-phase one students reported that they would find this 'easy' (26 per cent) or 'very easy' (64 per cent).

There was no statistical difference in terms of Leaving Certificate students' confidence to **solve problems using the properties of different shapes** (for example, to find the surface area and volume of a range of solids), although in general students appeared less confident in this area than other topics within Strand 2 (56 per cent of phase one students reported that they would find this 'easy' or 'very easy', compared to 62 per cent of non-phase one students). Again, this similarity is perhaps to be expected as both groups have studied this strand of the revised syllabus (Appendix B, Table 52).

8.2.4 Strand 3: Number

Key messages

Across both groups, **Leaving Certificate students had mixed views about their confidence in items relating to Strand 3, Number**. They expressed similar levels of confidence in understanding indices, and using formulae to solve problems in measurement. As the two groups have followed different syllabus pathways in relation to the topics covered in this strand, this suggests that the revised syllabus has had little impact on students within this strand of learning at Leaving Certificate level.

Despite phase one and non-phase one groups having followed different syllabus pathways in relation to the topics covered in this strand (with phase one students following the revised mathematics syllabus, and non-phase one students the previous mathematics syllabus) there were no statistically significant differences in their confidence to approach mathematical problems relating to number. Students in both groups had mixed views about their confidence in this area: half (50 per cent) of phase one students reported that they would find it 'easy' or 'very easy' to **understand indices**, for example, compared to 57 per cent of non-phase one students. Similarly, just over half (53 per cent) of phase one students reported that they would find it 'easy' or 'very easy' to **use formulae to solve problems in measurement**, compared to three-fifths (60 per cent) of non-phase one students (Appendix B, Tables 53-54).

These findings suggest that the revised syllabus has had little impact on students within this strand of learning at Leaving Certificate level. This contrasts with the findings of the Junior Certificate survey, where the revised syllabus appears to have had a slightly downward impact on particular aspects of this strand.

8.2.5 Strand 4: Algebra

Key messages

Although the responses of both groups of Leaving Certificate students were broadly positive in items relating to Strand 4, Algebra, those following all strands of the revised syllabus appeared slightly less confident than those following only Strands 1-2.

This suggests that **students following this strand of the revised syllabus may have found the topics covered more difficult to grasp than those experiencing the more established teaching and learning approaches of the previous syllabus**. This is reflected in the findings of the assessment part of this research, which showed that students following this strand of the revised syllabus appeared to find items relating to Strand 4 more challenging than other areas.

Students were asked how confident they would feel to solve problems in using algebra: for example, to find the value of x when 4x+3 =2x+11. The findings are presented in Table 8.15:

Table 8.15: If I were asked to solve problems using algebra…

	Phase one %	Non-phase one %
I would find it very easy	28	42
I would find it easy	34	32
I would find it a little difficult	26	17
I would find it very difficult	11	8
No response	2	2
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 299 phase one students, and 2,004 comparison group students, gave at least one response to these questions.
Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 8.15 shows that:

- non-phase one students were more confident at solving problems using algebra than phase one students. However, the findings for both groups were positive
- just under two-thirds (62 per cent) of phase one students reported that they would find it 'easy' (34 per cent) or 'very easy' (28 per cent)
- almost three-quarters of phase one students (74 per cent) reported that they would find it 'easy' (32 per cent) or 'very easy' (42 per cent).

There is a statistically significant difference between the two groups, which indicates that, in general, phase one students found algebra more challenging than students in the non-phase one group. The reasons for this will be explored further during the case-study phase. As with the Junior Certificate students, the two groups may take different approaches interpreting this type of question, which could explain any differences in students' confidence.

8.2.6 Strand 5: Functions

Key messages

Both groups of Leaving Certificate students were highly confident in relation to Strand 5, Functions, as measured by an item exploring their confidence in their ability to use graphs to represent information. A greater proportion of Leaving Certificate students following all strands of the syllabus, however, reported that they would be confident to approach this task (although, interestingly, they had considerable difficulty with this strand in the testing part of the research).

This indicates that the revised mathematics syllabus is positively influencing students' confidence in relation to functions, albeit from a relatively high baseline: students who had not followed this strand were also highly confident.

In relation to Strand 5 of the revised syllabus, students were asked how confident they would feel to **represent relationships between numbers graphically**. The findings are presented in Table 8.16:

Table 8.16: If I were asked to represent this relationship in a graph…

	Phase one %	Non-phase one %t
I would find it very easy	51	50
I would find it easy	41	35
I would find it a little difficult	6	11
I would find it very difficult	2	2
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 299 phase one students, and 2,004 comparison group students, gave at least one response to these questions.
Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 8.16 shows that:

- both phase one and non-phase one students were highly confident in using graphs to represent information.
- phase one students were slightly more confident with 92 per cent responding they would find it 'easy' (41 per cent) or 'very easy' (51 per cent).

- by contrast, 85 per cent of non-phase one students responded that they would find it 'easy' (35 per cent) or 'very easy' (50 per cent) to represent this relationship in a graph.

This finding is statistically significant, and indicates that the revised mathematics syllabus is positively influencing students' confidence in relation to functions. However, as detailed in section 7.4.5, phase one students had considerable difficulty with this strand in the testing part of the research, suggesting that their may be a mismatch between their confidence and abilities in this area.

8.2.7 All strands: Synthesis and problem solving

Key messages

In general, both groups of Leaving Certificate students appeared confident in their abilities to apply their mathematics to real life situations, synthesise their mathematical learning across more than one strand of learning. Furthermore, a greater proportion of students following all strands of the syllabus reported that they were confident in undertaking these tasks: this is a highly encouraging reflection of the positive impact of the revised syllabus.

Students tended, however, to lack confidence in their ability to **solve mathematics problems using what they have learned in more than one mathematics topic**, with students following all strands of the revised syllabus appearing less confident than those studying Strands 1 and 2. This suggests that whilst students feel confident that they can effectively make connections between different mathematics topics, they do not yet feel as confident that they can directly apply this knowledge.

Across all strands of the revised syllabus, students are expected to be able to **use mathematics to solve problems based on real-life situations**. In general, both phase one and non-phase one students reported that they were confident in this area. Like their Junior Certificate peers, however, Leaving Certificate phase one students appeared to feel somewhat less confident than non-phase one students. Almost three-quarters (72 per cent) of phase one students reported that they would find it 'easy' (43 per cent) or 'very easy' (29 per cent) to use mathematics to solve problems based on real-life situations, compared to four-fifths (80 per cent) of non-phase one students who reported that they would find this 'easy' (45 per cent) or 'very easy' (35 per cent) (Appendix B, Table 55). This is a statistically significant difference, and, like the Junior Certificate survey, is particularly notable as students in the phase one group reported that they applied mathematics to real-life situations much more commonly than the non-phase one group. As suggested earlier in this report, one possible explanation for this is that, as phase one students do this more frequently than their non-phase one counterparts, they have been encouraged to test out and challenge their skills in this area to a greater degree. Likewise, as discussed in relation to the findings of the Junior Certificate survey, it may also be possible that there are competing conceptions of what is meant by 'problem-solving' in this context.

Similarly, across all strands of the revised syllabus, students are expected to demonstrate their ability to **synthesise what they have learned in more than one topic, and apply it to solving a range of mathematical problems**. For Leaving Certificate students, unlike Junior Certificate students, there was a statistically significant difference between phase one and non-phase one groups. Whilst half (50 per cent) of phase one students reported that they would find it 'easy' (42 per cent) or 'very easy' (eight per cent) to gather all the information available, and then use it to solve a particular mathematics problem, non-phase one students appeared to feel more confident. Overall, 57 per cent of non-phase one students reported that they would find this 'easy' (43 per cent) or 'very easy' (14 per cent) (Appendix B, Table 56).

There was no statistically significant difference, however, in students' confidence to solve **mathematics problems using what they have learned in more than one mathematics topic**, although in general, students in both groups appeared to lack confidence in this area. Just over two-fifths (41 per cent) of phase one students reported that they would find this 'easy' or 'very easy', compared to 53 per cent of non-phase one students (Appendix B, Table 57). This suggests that whilst students felt confident that they can effectively make connections between different mathematics topics, they do not yet feel as confident that they can directly apply this knowledge.

8.2.8 General attitudes towards mathematics

Key messages

Both groups of Leaving Certificate students held similarly positive attitudes towards mathematics in general. Whereas Junior Certificate students who had followed the revised syllabus reported that they felt less confident in their mathematical ability relative to their peers, compared to students who followed the previous syllabus, there was no such distinction between Leaving Certificate groups.

In order to understand students' perceptions of their own abilities and levels of engagement with mathematics, participating students were asked to comment on the extent of their agreement with a range of statements about learning mathematics. The areas explored included students':

- confidence in their own mathematical ability, and in their ability relative to their peers
- enjoyment of mathematics, and the process of learning mathematics
- interest in studying more mathematics in school.

Overall, Leaving Certificate students in both phase one and non-phase one groups reported similarly positive views about learning mathematics and, in most areas, there were no statistically significant differences between the two groups. This

includes students' **confidence in their mathematical ability relative to their peers**, an area in which Junior Certificate phase one students felt significantly less confident than their comparison group peers. This indicates that, overall, the revised syllabus has not influenced students' general attitudes towards mathematics, despite the many changes associated with the implementation of a new syllabus, which in itself is a positive finding (Appendix B, Tables 58-64). Indeed, just 42 per cent of phase one students reported that the way they learned mathematics at Leaving Certificate was the same as Junior Certificate, compared to 60 per cent of Junior Certificate students (Appendix B, Table 65).

There was, however, a statistically significant difference in relation to the extent to which Leaving Certificate students agreed that they **would like to take more mathematics in school**. The findings are presented in Table 8.17:

Table 8.17: I would like to take more maths in school

	Phase one %	Non-phase one %
Often	11	17
Sometimes	24	26
Rarely	28	28
Never	36	27
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,995 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 8.17 shows that whilst, in general, students in both groups were not especially positive that they would like to study more mathematics in school, phase one students were less likely to report that this was the case than non-phase one students. Just 35 per cent of phase one students agreed either 'a little' (24 per cent) or 'a lot' (11 per cent) that they would like to take more mathematics in school, compared to 43 per cent of non-phase one students who agreed either 'a little' (26 per cent) or 'a lot' (17 per cent) that this was the case

8.2.9 Discussion

Again, this section highlights the many areas in which phase one students appear to feel confident in their mathematics learning. It is of particular interest that within Strands 1 and 2, there are areas where phase one students are more confident than their non-phase one peers, despite having followed the same syllabus as their non-phase one peers. This may require further exploration in subsequent phases of this research to determine whether there are school-based factors contributing to this difference (e.g. the revised syllabus is more embedded), or whether instead following a greater number of strands leads to benefits in all strands of the revised syllabus.

8.3 Students' attitudes towards careers involving mathematics

Key messages

Like Junior Certificate students, both groups of Leaving Certificate students reported that **mathematics was important in a range of contexts outside of the classroom**, but shared their views regarding the scope and range of careers which may involve mathematics.

Nonetheless, many Leaving Certificate students were planning to pursue further study and/or careers in mathematics**, favouring professions such as accountancy and business management.**

To gain an understanding of students' attitudes towards careers involving mathematics, the survey explored students' knowledge of, and perspectives on:

- the wider application of mathematics beyond the classroom
- the range of jobs and career pathways involving mathematics.

8.3.1 Students' understanding of the wider application of mathematics

To ascertain Leaving Certificate students' views on the broader application of mathematics, they were asked to comment on the extent to which they perceived it to be useful in the following ways:

- to help in daily life
- to aid learning in other school subjects
- to enable them to get into the university of their choice
- to enable them to get the job of their choice.

The findings showed that, whilst both groups of students were in broad agreement that mathematics was important in each of these areas, albeit to a lesser extent than

their Junior Certificate counterparts (between 51 per cent and 67 per cent of phase one students agreed 'a little' or 'a lot' that mathematics was important in each of these areas, as did between 49 per cent and 69 per cent of comparison group students), there were no statistically significant differences between phase one and non-phase one students in any of these areas (Appendix B, Tables 66-69).

8.3.2 Students' understanding of jobs involving mathematics

To explore students' understanding of jobs and career pathways involving mathematics, they were provided with a list of ten different professions, all involving mathematics in a variety of different ways. Students were then asked to select which of these roles involved using mathematics. These professions, in rank order according to the proportion of students indicating positively that they involve mathematics, are shown in Table 8.18:

Table 8.18: Proportion of Leaving Certificate students indicating that mathematics is involved in each profession

	Phase one students	Non-phase one students
80-100 per cent	Accountant	Accountant
	Engineer	Engineer
	Owning a business	Owning a business
	Scientist	Scientist
	Working with technology	Sales assistant
	Sales assistant	Working with technology
50-70 per cent	Doctor	Doctor
	Dietician	Dietician
40-50 per cent	Fashion designer	Fashion designer
	Nurse	Nurse

Table 8.18 shows that, like the Junior Certificate survey, there are no substantial differences between students' views on which of these roles involve using mathematics. Again, students in both groups reported most strongly that this was the case for jobs involving a clear mathematical component (for example, **accountancy, or owning a business**): over 90 per cent of students in both phase one and non-phase one schools identified that this was the case. Over 90 per cent of both groups at Leaving Certificate level also identified that **engineering** also involved mathematics.

Next, students in both phase one and non-phase one schools strongly identified that careers in other STEM subjects involved mathematics, including **science and technology** (over 85 per cent of students in both phase one and non-phase one schools identified that this was the case).

Whilst overall, Leaving Certificate students did not perceive as strongly that careers in the **medical profession** involved using mathematics, they did so more than their Junior Certificate peers: 68 per cent of Leaving Certificate phase one students, and 59 per cent of non-phase one students, reported, for example, that being a doctor would require mathematics. This reflected a generally higher recognition of the role of mathematics in all professions, than was present at Junior Certificate (Appendix B, Table 70-79).

8.3.3 Interest in a career in mathematics

Leaving Certificate students were asked about their future plans to study and pursue careers in mathematics, to ascertain the extent to which the revised syllabus is having an impact on students' aspirations in this area.

The vast majority of students (91 per cent from both phase one and non-phase one schools) reported that that they were considering further study after finishing their Leaving Certificate (Appendix B, Table 80), and almost half of these students (49 per cent of phase one students, and 47 per cent of non-phase one students) indicated that they would be **going to university to do a course involving 'some' or 'a lot' of mathematics**. Around one-third of students (33 per cent of phase one students, and 35 per cent of non-phase one students) reported they would be doing a course that did not involve mathematics at university (Appendix B, Table 81). The remainder of students in both phase one and non-phase one schools were planning to take a technical or vocational course, an apprenticeship, or training for a variety of different careers (Appendix B, Table 82).

Just over one-third of students from both phase one and non-phase one schools (34 per cent, and 32 per cent, respectively) were considering doing a job that involves mathematics in the future (Appendix B, Table 83). Most commonly, these students reported that these jobs may include teaching; finance and accountancy; business and management; and science (Appendix B, Table 84).

8.3.4 Discussion

The findings presented in this section indicate that, as found in the Junior Certificate survey, the introduction of the revised mathematics syllabus has not, to date, had any discernible impact on students' appreciation of the application of mathematics outside of the classroom (although again, in general, students in both phase one and non-phase one groups had broadly positive views in this regard).

Leaving Certificate students' responses also echo those of their Junior Certificate peers regarding their perceptions of the range of professions involving mathematics.

Nonetheless, the findings positively indicate that many Leaving Certificate students are keen to go on to further study and careers in mathematics. It may, therefore, be valuable to explore ways in which Leaving Certificate students can be encouraged to broaden their understanding of the ways that mathematics can be applied in the workplace, to support them in making informed decisions about their future study and career choices.

9. Overview and next steps

This section provides a brief overview and discussion of the assessment and survey findings, as a basis for further exploration in subsequent phases of the research.

Assessment of students' performance reveals that, overall, students are performing well in many aspects of the revised mathematics syllabus. Furthermore, parallels between the assessment of students' performance and findings of the attitude survey suggest that students are reflective about their experiences of learning mathematics, and in most cases able to identify their own areas of strengths and weaknesses[23]. Both Junior Certificate and Leaving Certificate students are performing particularly highly in relation to Strand 1, Statistics and Probability, for example, which is reflected in the high degree of confidence reported in relation to this strand. By contrast, students who had followed the revised syllabus appeared to find Strand 4, Algebra, more difficult which is, again, identified as an area in which students lack confidence, relative to their comparison group peers.

There do not yet appear to be any discernible differences in skills of students following the introduction of the revised mathematics syllabus, relative to their peers, as measured by the items contained in the indicator item booklets. At Leaving Certificate level, this is perhaps to be expected given that both groups of students have studied Strand 1 and 2 of the revised mathematics syllabus (although there were particular areas, for example analysing verbal geometric information and translating it into mathematical form, in which phase one students appeared more proficient, suggesting that they had benefited from greater immersion in the revised syllabus). At Junior Certificate level, however, there is no discernible difference despite students having followed different syllabus pathways: this suggests that the revised syllabus is not, as yet, having a significant impact on students' performance.

The student attitude survey of both Junior Certificate and Leaving Certificate students, however, shows that those who have studied the revised mathematics syllabus positively identify a range of teaching techniques central to the aims of the new syllabus, including the application of mathematics to real-life situations; making connections and links between mathematics topics; using mathematical language and verbal reasoning to convey ideas; and planning and conducting investigations. Whilst many students report that they have found it challenging to adapt to the new approaches to learning mathematics promoted though the revised syllabus (and again, this is corroborated by the assessment data which reveals that at both Junior Certificate and Leaving Certificate level, higher order skills, such as reasoning and an ability to transfer knowledge to new contexts, are found more difficult than those

[23] Leaving Certificate students' gave a more mixed picture in relation to Strand 5, Functions. Whilst students appeared highly confident in relation to this strand, they experienced some difficulties in the assessment part of the research.

which are more mechanical in demand), it is positive that they have remained confident in their mathematical abilities and skills throughout. This is particularly notable for Leaving Certificate students, who did not have any experience of the teaching approaches promoted in the revised syllabus at Junior Certificate level. Furthermore, students who are following the revised syllabus appear to be acquiring a growing knowledge of the application of mathematics outside of the classroom, and within a range of different professions.

9.1 Next steps

The early findings outlined in this report provide a sound basis for further exploration throughout this research, which includes:

- attitude surveys and assessment of performance with a further cohort of Junior Certificate and Leaving Certificate students in Autumn 2012
- ongoing, in-depth case studies in eight phase one, and eight non-phase one schools: this includes further exploration of many of the specific issues arising from this phase of the research
- qualitative analysis of students' work in Autumn 2012, exploring the processes being promoted in the revised syllabus.

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Appendix A

Student achievement data tables, Spring 2012

Table 1: Origin of items used in the Junior Certificate item indicator booklets

Indicator Item Booklet	Item	Syllabus area assessed	Source of items	
			TIMSS	PISA
JC1/2	1	1.2	TIMSS 2007 - Grade 8	
	2	1.7	TIMSS 2007 - Grade 8	
	3	1.6	TIMSS 2007 - Grade 8	
	4	1.3	TIMSS 2007 - Grade 8	
	5	1.6	TIMSS 2007 - Grade 8	
	6a	1.7	TIMSS 2007 - Grade 8	
	6b	1.7	TIMSS 2007 - Grade 8	
	6c	1.7	TIMSS 2007 - Grade 8	
	7a	1.6	TIMSS 2007 - Grade 8	
	7b	1.7	TIMSS 2007 - Grade 8	
	8	1.3	TIMSS 2007 - Grade 8	
	9	1.4	TIMSS 2007 - Grade 8	
	10	1.3	TIMSS 2007 - Grade 8	
	11	1.4		✓
	12	2.3	TIMSS 2007 - Grade 8	
	13	2.1	TIMSS 2007 - Grade 8	
	14	2.1	TIMSS 2007 - Grade 8	
	15	2.1	TIMSS 2007 - Grade 8	
	16	2.1	TIMSS 2007 - Grade 8	
	17	2.2	TIMSS 2007 - Grade 8	
	18	2.3	TIMSS 2007 - Grade 8	
	19	2.1	TIMSS 2007 - Grade 8	
	20	2.1	TIMSS 2007 - Grade 8	
	21	2.1	TIMSS 2007 - Grade 8	
JC3/4	1	3.1	TIMSS 2007 - Grade 8	
	2	3.2	TIMSS 2007 - Grade 8	
	3	3.1	TIMSS 2007 - Grade 8	
	4	3.1	TIMSS 2007 - Grade 8	
	5	3.4	TIMSS 2007 - Grade 8	
	6	3.1	TIMSS 2007 - Grade 8	
	7	3.1	TIMSS 2007 - Grade 8	
	8	3.4		✓
	9	3.4		✓
	10a	3.3		✓
	10b	3.3		✓
	11	3.1		✓
	12	4.2	TIMSS 2007 - Grade 8	
	13a	4.2		✓
	13b	4.4		✓
	13c	4.4		✓
	14	4.5		✓

	15	4.7	TIMSS 2007 - Grade 8	
	16	4.6	TIMSS 2007 - Grade 8	
	17	4.3	TIMSS 2007 - Grade 8	
	18	4.6	TIMSS 2007 - Grade 8	
	19	4.6	TIMSS 2007 - Grade 8	
	20	4.4	TIMSS 2007 - Grade 8	
	21	4.3	TIMSS 2007 - Grade 8	

Table 2: Origin of items used in the Leaving Certificate item indicator booklets

Indicator Item Booklet	Item	Syllabus area assessed	Source of items	
			TIMSS	PISA
SPLC1	1	1.2		✓
	2	1.2		✓
	3	1.4		✓
	4	1.3	TIMSS 2007 - Grade 8	
	5	1.6		✓
	6	1.4		✓
	7a	1.6	TIMSS 2007 - Grade 8	
	7b		TIMSS 2007 - Grade 8	
	8	1.4		✓
	9	1.4		✓
GTLC2	1	2.1		✓
	2a	2.1	TIMSS 2007 - Grade 8	
	2b			
	3	2.1	TIMSS 2007 - Grade 8	
	4	2.1	TIMSS 2007 - Grade 8	
	5	2.1	TIMSS 2008 (Advanced)	
	6	2.2	TIMSS 2008 (Advanced)	
	7	2.2	TIMSS 2008 (Advanced)	
	8a	2.3	TIMSS 2008 (Advanced)	
	8b			
	9	2.2	TIMSS 2008 (Advanced)	
	10a	2.3	TIMSS 2008 (Advanced)	
	10b			
NLC3	1	3.4		✓
	2	3.1		✓
	3	3.4		✓
	4	3.4		✓
	5	3.5		✓
	6	3.1	TIMSS 2008 (Advanced)	
	7	3.1	TIMSS 2008 (Advanced)	
	8a	3.1		✓
	8b			
	9	3.4		✓
	10	3.1	TIMSS 2008 (Advanced)	
ALC4	1a	4.1		✓
	1b			
	2a	4.1		✓

	2b			
	3	4.4	TIMSS 2008 (Advanced)	
	4	4.3	TIMSS 2008 (Advanced)	
	5	4.3	TIMSS 2008 (Advanced)	
	6	4.1	TIMSS 2008 (Advanced)	
	7	4.2	TIMSS 2008 (Advanced)	
FLC5	1	5.1		✓
	2	5.2	TIMSS 2008 (Advanced)	
	3	5.1		✓
	4a	5.2	TIMSS 2008 (Advanced)	
	4b			
	5	5.2	TIMSS 2008 (Advanced)	
	6	5.1	TIMSS 2008 (Advanced)	
	7a	5.2	TIMSS 2008 (Advanced)	
	7b			
	8	5.2	TIMSS 2008 (Advanced)	
	9	5.2	TIMSS 2008 (Advanced)	

Junior Certificate indicator items: comparison of phase one and non-phase one schools

Table 3 compares the performance of phase one and non-phase one schools, including analysis using the statistical method of differential item functioning analysis. This highlights item-by-item differences, where comparison group students did better, or less well, than their phase-one peers.

Differential item functioning is analysed using the Logistic Regression Approach. The basic purpose of this approach is to calculate the probability of particular groups of students (in this case phase one or comparison group students) getting each item correct, in relation to the probability of the whole sample getting those items correct. The output of differential item function analysis is in the form of a coefficient and the significance of the coefficient is calculated, i.e. the probability that such a value could have arisen by chance and that there is in reality no difference between the two groups. Three measures of significance for differential functioning are given:

- significance at the 5 per cent level ($p < 0.05$): less than 5 per cent probability that the difference is due to chance;
- significance at the 1 per cent level ($p < 0.01$): less probable that the difference arose by chance;
- significance at the 0.1 per cent level ($p < 0.001$): improbable that the difference arose by chance.

It should be noted that similar findings may not occur with a different sample. Past experience suggests that this is particularly the case for those differences which are significant only at the 5 per cent level.

Table 3: Junior Certificate indicator items – comparison of phase one and non-phase one schools

Indicator Item Booklet	Item	Syllabus area assessed	Phase One Students		Non-phase One Students		Significant difference (%)
			Facility (%)	% Omit	Facility (%)	% Omit	
JC1/2	1	1.2	87	1	87	0	none
	2	1.7	96	0	95	1	none
	3	1.6	≥1m: 68 2m: 62	3	≥1m: 68 2m: 60	4	none
	4	1.3	86	1	76	1	**1**
	5	1.6	95	1	94	1	none
	6a	1.7	≥1m: 64 2m: 47	14	≥1m: 61 2m: 40	17	none
	6b	1.7	≥1m: 57 2m: 33	17	≥1m: 55 2m: 28	17	none
	6c	1.7	47	16	47	17	none
	7a	1.6	73	2	74	1	none
	7b	1.7	≥1m: 76 2m: 41	1	≥1m: 74 2m: 37	1	none
	8	1.3	71	1	70	2	none
	9	1.4	22	2	19	3	none
	10	1.3	60	5	52	10	none
	11	1.4	≥1m: 54 2m: 17	10	≥1m: 45 2m: 13	12	none
	12	2.3	87	2	82	2	none
	13	2.1	59	4	52	3	none
	14	2.1	67	3	59	4	none
	15	2.1	64	5	68	4	none
	16	2.1	37	4	40	4	none
	17	2.2	76	4	81	4	5
	18	2.3	73	4	65	5	none
	19	2.1	51	19	46	17	none
	20	2.1	35	14	41	15	**1**
	21	2.1	65	5	56	8	none
JC3/4	1	3.1	77	1	-	-	-
	2	3.2	90	0	-	-	-
	3	3.1	69	2	-	-	-
	4	3.1	50	9	-	-	-
	5	3.4	83	1	-	-	-
	6	3.1	72	2	-	-	-
	7	3.1	59	2	-	-	-
	8	3.4	≥1m: 3 2m: 0	11	-	-	-
	9	3.4	93	2	-	-	-
	10a	3.3	74	3	-	-	-
	10b	3.3	34	11	-	-	-
	11	3.1	10	3	-	-	-
	12	4.2	≥1m: 29 2m: 17	8	-	-	-
	13a	4.2	≥1m: 74 2m: 66	2	-	-	-
	13b	4.7	29	37	-	-	-
	13c	4.4	≥1m: 21 2m: 9	31	-	-	-
	14	4.5	14	18	-	-	-
	15	4.7	38	4	-	-	-
	16	4.6	73	4	-	-	-
	17	4.3	65	4	-	-	-
	18	4.6	54	5	-	-	-
	19	4.7	57	4	-	-	-

	20	4.4	36	5	-	-	-
	21	4.3	46	5	-	-	-

Junior Certificate indicator items: comparison with international performance

Table 4 presents the average scores of the phase one students and compares them with the international average scores in the 2007 TIMSS study. The difference in item facilities is also shown. These differences are indicative, as significance tests could not be carried out.

Items have been shaded to ease comparison. If the difference is less than 10 percentage points, the item has not been shaded as it is possible that any difference in performance is due to sampling effects. Green denotes items on which phase one students have substantially higher facilities and orange indicates items on which the international students have scored considerably more highly. If the difference is 10-24 percentage points the item has a pale shading while differences of 25 percentage points and more have darker shading.

Comparative data is available for 22 out of 24 items or item parts of JC1/2.

Table 4: Junior Certificate indicator items – comparison with international performance (TIMSS items only)

Indicator Item Booklet	Item	Syllabus area assessed	Phase One Facility (%)	International Facility (%)	Difference in facility (percentage points)
JC1/2	1	1.2	87	63	-24
	2	1.7	96	64	-32
	3	1.6	≥1m: 68 2m: 62	≥1m: 34 2m: 29	≥1m: -34 2m: -33
	4	1.3	86	44	-42
	5	1.6	95	75	-20
	6a	1.7	≥1m: 64 2m: 47	≥1m: 29 2m: 17	≥1m: -35 2m: -30
	6b	1.7	≥1m: 57 2m: 33	≥1m: 24 2m: 10	≥1m: -33 2m: -23
	6c	1.7	47	23	-24
	7a	1.6	73	41	-32
	7b	1.7	≥1m: 76 2m: 41	≥1m: 47 2m: 20	≥1m: -29 2m: -21
	8	1.3	71	49	-22
	9	1.4	22	-	-
	10	1.3	60	31	-29
	11	1.4	≥1m: 54 2m: 17	-	-
	12	2.3	87	68	-19
	13	2.1	59	33	-26
	14	2.1	67	51	-16
	15	2.1	64	59	-5
	16	2.1	37	32	-5
	17	2.2	76	51	-25
	18	2.3	73	57	-16
	19	2.1	51	39	-12
	20	2.1	35	28	-7
	21	2.1	65	42	-23
JC3/4	1	3.1	77	64	-13

	2	3.2	90	70	-20
	3	3.1	69	47	-22
	4	3.1	50	19	-31
	5	3.4	83	63	-20
	6	3.1	72	55	-17
	7	3.1	59	44	-15
	8	3.4	≥1m: 3 2m: 0	-	-
	9	3.4	93	-	-
	10a	3.3	74	-	-
	10b	3.3	34	-	-
	11	3.1	10	-	-
	12	4.2	≥1m: 29 2m: 17	≥1m: 19 2m: 9	≥1m: -10 2m: -8
	13a	4.2	≥1m: 74 2m: 66	-	-
	13b	4.4	29	-	-
	13c	4.4	≥1m: 21 2m: 9	-	-
	14	4.5	14	-	-
	15	4.7	38	64	26
	16	4.6	73	70	-3
	17	4.3	65	47	-18
	18	4.6	54	19	-35
	19	4.6	57	63	6
	20	4.4	36	55	19
	21	4.3	46	44	-2

Leaving Certificate indicator items: comparison of phase one and non-phase one schools

Table 5 presents the scores of phase one and non-phase one students who completed booklets SPLC1 and GTLC2 (non-phase one students did not sit booklets NCL3, ALC4 or FLC5). This allows for a basic comparison of performance between phase one and non-phase one students. Their average scores on each item are compared using the statistical analysis of differential item functioning. This highlights item-by-item differences, where non-phase one students did better, or less well, than their phase one peers.

Differential item functioning is analysed using the Logistic Regression Approach. The basic purpose of this approach is to calculate the probability of particular groups of students (in this case phase one or non-phase one students) getting each item correct, in relation to the probability of the whole sample getting those items correct. The output of differential item function analysis is in the form of a coefficient and the significance of the coefficient is calculated, i.e. the probability that such a value could have arisen by chance and that there is in reality no difference between the two groups. Three measures of significance for differential functioning are given:

- significance at the 5 per cent level ($p < 0.05$): less than 5 per cent probability that the difference is due to chance;
- significance at the 1 per cent level ($p < 0.01$): less probable that the difference arose by chance;
- significance at the 0.1 per cent level ($p < 0.001$): improbable that the difference arose by chance.

It should be noted that similar findings may not occur with a different sample. Past experience suggests that this is particularly the case for those differences which are significant only at the 5 per cent level.

Table 5: Leaving Certificate indicator items - comparison of phase one and non-phase one schools

Indicator Item Booklet	Item	Syllabus area assessed	Phase One Students		Non-phase One Students		Significant difference (%)
			Facility (%)	% Omit	Facility (%)	% Omit	
SPLC1	1	1.2	61	2	62	2	none
	2	1.2	67	3	62	3	none
	3	1.4	≥1m: 58 2m: 28	3	≥1m: 51 2m: 21	7	none
	4	1.3	70	2	61	5	none
	5	1.6	66	3	56	7	none
	6	1.4	1	2	1	4	none
	7a	1.6	80	2	75	6	none
	7b		≥1m: 79 2m: 42	2	≥1m: 73 2m: 39	7	none
	8	1.4	≥1m: 63 2m: 58	8	≥1m: 58 2m: 49	18	none
	9	1.4	49	17	38	25	none
GTLC2	1	2.1	59	4	48	3	**1**
	2a	2.1	77	5	68	6	5
	2b		≥1m: 20 2m: 18	49	≥1m: 13 2m: 10	53	5
	3	2.1	51	2	47	2	none
	4	2.1	67	5	68	4	none
	5	2.1	28	9	28	6	none
	6	2.2	34	8	41	9	5
	7	2.2	17	9	18	16	none
	8a	2.3	31	19	25	19	none
	8b		13	50	14	50	none
	9	2.2	≥1m: 30 2m: 22	31	≥1m: 36 2m: 30	32	**1**
	10a	2.3	12	27	18	29	none
	10b		≥1m: 11 2m: 1	70	≥1m: 13 2m: 0	70	none
NLC3	1	3.4	82	5	-	-	-
	2	3.1	29	13	-	-	-
	3	3.4	42	3	-	-	-
	4	3.4	≥1m: 47 2m: 14	2	-	-	-
	5	3.5	71	4	-	-	-
	6	3.1	35	6	-	-	-
	7	3.1	18	14	-	-	-
	8a	3.1	59	7	-	-	-
	8b		≥1m: 36 2m: 25	24	-	-	-
	9	3.4	23	9	-	-	-
	10	3.1	14	61	-	-	-
ALC4	1a	4.1	82	2	-	-	-
	1b		25	12	-	-	-
	2a	4.1	≥1m: 84 2m: 76	9	-	-	-
	2b		≥1m: 47 2m: 34	17	-	-	-
	3	4.4	13	10	-	-	-
	4	4.3	26	10	-	-	-
	5	4.3	8	19	-	-	-
	6	4.1	16	11	-	-	-

	7	4.2	5	38	-	-	-
FLC5	1	5.1	34	3	-	-	-
	2	5.2	9	12	-	-	-
	3	5.1	77	3	-	-	-
	4a	5.2	2	34	-	-	-
	4b		1	46	-	-	-
	5	5.2	3	33	-	-	-
	6	5.1	21	10	-	-	-
	7a	5.2	15	35	-	-	-
	7b		2	46	-	-	-
	8	5.2	28	17	-	-	-
	9	5.2	24	16	-	-	-

Table 6: Comparison of Common Items – phase one students

Indicator Item Booklet	Item	Indicator Item Booklet	Item	Syllabus area assessed	Phase One JC Students		Phase One LC Students	
					Facility (%)	% Omit	Facility (%)	% Omit
JC1/2	7a	**SPLC1**	7a	1.6	73	2	80	2
	7b		7b	1.7	≥1m: 76 2m: 41	1	≥1m: 79 2m: 42	2
	10		4	1.3	60	5	70	2
	11		3	1.4	≥1m: 54 2m: 17	10	≥1m: 58 2m: 28	3
	14	**GTLC2**	2a	2.1	67	3	77	5
	16		3	2.1	37	4	51	2
	21		4	2.1	65	5	67	5

Table 7: Comparison of common items – non-phase one students

Indicator Item Booklet	Item	Indicator Item Booklet	Item	Syllabus area assessed	Non-phase One JC Students		Non-phase One LC Students	
					Facility (%)	% Omit	Facility (%)	% Omit
JC1/2	7a	**SPLC1**	7a	1.6	74	1	75	6
	7b		7b	1.7	≥1m: 74 2m: 37	1	≥1m: 73 2m: 39	7
	10		4	1.3	52	10	61	5
	11		3	1.4	≥1m: 45 2m: 13	12	≥1m: 51 2m: 21	7
	14	**GTLC2**	2a	2.1	59	4	68	6
	16		3	2.1	40	4	47	2
	21		4	2.1	56	8	68	4

Leaving Certificate indicator items: comparison with international performance

Table 8 presents the average scores of the phase one students and compares them to the international average scores in the 2007 TIMSS and 2008 TIMSS Advanced studies. The difference in item facilities is also shown and each item has been shaded to ease comparison. If the difference is less than 10 percentage points, the item has not been shaded as it is possible that any difference in performance is due to sampling effects. Green denotes items on which phase one students have substantially higher facilities and orange indicates items on which the international students have scored considerably more highly. If the difference is 10-24 percentage points the item has a pale shading while differences of 25 percentage points and more have darker shading.

Comparative data is available for three of the items in SPLC1: items 4, 7a and 7b. The remaining items were released PISA items and so, no international data is available. Table 7.6 below shows the number of items with differences in facility that fall within the three performance bands as described above.

Table 8: Leaving Certificate indicator items - comparison with international performance

Indicator Item Booklet	Item	Syllabus area assessed	Phase One Facility (%)	International Facility (%)	Difference in facility (percentage points)
SPLC1	1	1.2	61	-	-
	2	1.2	67	-	-
	3	1.4	≥1m: 58 2m: 28	-	-
	4	1.3	70	31	-39
	5	1.6	66	-	-
	6	1.4	1	-	-
	7a	1.6	80	41	-39
	7b		≥1m: 79 2m: 42	≥1m: 47 2m:20	≥1m: -32 2m:-22
	8	1.4	≥1m: 63 2m: 58	-	-
	9	1.4	49	-	-
GTLC2	1	2.1	59	-	-
	2a	2.1	77	51	-26
	2b		≥1m: 20 2m: 18	-	-
	3	2.1	51	32	-19
	4	2.1	67	42	-25
	5	2.1	28	68	40
	6	2.2	34	54	20
	7	2.2	17	24	7
	8a	2.3	31	38	7
	8b		13	-	-
	9	2.2	≥1m: 30 2m: 22	≥1m: 36 2m:29	≥1m: 6 2m: 7

	10a	2.3	12	26	14
	10b		≥1m: 11 2m: 1	-	-
NLC3	1	3.4	82	-	-
	2	3.1	29	-	-
	3	3.4	42	-	-
	4	3.4	≥1m: 47 2m: 14	-	-
	5	3.5	71	-	-
	6	3.1	35	51	16
	7	3.1	18	39	21
	8a	3.1	59	-	-
	8b		≥1m: 36 2m: 25	-	-
	9	3.4	23	-	-
	10	3.1	14	23	9
ALC4	1a	4.1	82	-	-
	1b		25	-	-
	2a	4.1	≥1m: 84 2m: 76	-	-
	2b		≥1m: 47 2m: 34	-	-
	3	4.4	13	16	3
	4	4.3	26	45	19
	5	4.3	8	54	46
	6	4.1	16	26	10
	7	4.2	5	26	21
FLC5	1	5.1	34	-	-
	2	5.2	9	25	16
	3	5.1	77	-	-
	4a	5.2	2	41	39
	4b		1	15	14
	5	5.2	3	30	27
	6	5.1	21	54	33
	7a	5.2	15	52	37
	7b		2	18	16
	8	5.2	28	35	7
	9	5.2	24	31	7

Student achievement on Leaving Certificate Function items by student level

Table 9 compares the performance of the Ordinary Level and Higher Level students. Although five (3%) Foundation Level students completed the items in Table 9, none achieved a mark. Facilities for Foundation Level students are therefore not presented.

Generally the Higher Level students achieve higher average scores on each item than the Ordinary Level students, as might be anticipated. Since these facilities are based on relatively small numbers of pupils taking each item, they are not estimated to a high level of precision so should be treated with a degree of caution. This is even more so with the Higher-level pupils since there were only 63 of them. To estimate facility with a reasonable degree of precision we would usually need to sample around 400 pupils in each group to be reported.

In order to determine whether differences in facility between Ordinary and Higher-level students were significant, chi-squared tests were carried out. Levels of significance can be summarised as follows:

- significance at the 5 per cent level ($p < 0.05$): -less than 5 per cent probability that the difference is due to chance;
- significance at the 1 per cent level ($p < 0.01$): less probable that the difference arose by chance;
- significance at the 0.1 per cent level ($p < 0.001$): improbable that the difference arose by chance.

Table 9: Student achievement on Leaving Certificate Function items by student level

Item in Indicator Booklet FLC5	Achievement of Ordinary Level Students (%)	Achievement of Higher Level Students (%)	Significance (%)
4a	0	6	5
4b	0	2	Not significant
5	0	10	0.1
7a	8	29	0.1
7b	1	5	Not significant
8	27	33	Not significant
9	16	41	0.1

Ordinary Level, N=111 (62%); Higher Level, N = 63 (35%)

Appendix B

Attitude survey data tables, Spring 2012

Junior Certificate

How often do you do these things in your maths lessons?

Table 1: We show our working to justify our answers

	Phase one %	Comparison group %
Often	86	84
Sometimes	9	12
Rarely	1	2
Never	1	1
No Response	3	2
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 367 phase one students, and 2,361 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 2: We set goals and targets about our maths learning

	Phase one %	Comparison group %
Often	25	29
Sometimes	39	39
Rarely	23	21
Never	10	9
No Response	4	2
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 367 phase one students, and 2,361 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

How much do you agree with these statements about your maths lessons?

Table 3: My teacher sets me work to suit my abilities and interests

	Phase one %	Comparison group %
Agree a lot	14	17
Agree a little	42	38
Disagree a little	30	25
Disagree a lot	13	18
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 375 phase one students, and 2,375 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012

Table 4: My teacher gives me work that will challenge me to improve my skills

	Phase one %	Comparison group %
Agree a lot	61	59
Agree a little	31	33
Disagree a little	6	6
Disagree a lot	2	2
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 375 phase one students, and 2,366 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 5: I know what my teacher expects me to do

	Phase one %	Comparison group %
Agree a lot	59	62
Agree a little	29	29
Disagree a little	7	7
Disagree a lot	3	2
No response	2	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 375 phase one students, and 2,366 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 6: My teacher helps me to understand if I am finding something difficult during a maths lesson

	Phase one %	Comparison group %
Agree a lot	65	67
Agree a little	22	22
Disagree a little	9	7
Disagree a lot	4	3
No response	0	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 375 phase one students, and 2,366 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 7: My teacher thinks I can do well in maths

	Phase one %	Comparison group %
Agree a lot	59	61
Agree a little	33	29
Disagree a little	7	5
Disagree a lot	1	3
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 375 phase one students, and 2,366 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 8: My teacher will decide if I should do Foundation Level, Ordinary Level or Higher Level

	Phase one	Comparison group
	%	%
Agree a lot	18	19
Agree a little	35	29
Disagree a little	23	25
Disagree a lot	22	25
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 375 phase one students, and 2,366 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 9: My teacher explains maths in ways that make it interesting

	Phase one	Comparison group
	%	%
Agree a lot	30	28
Agree a little	35	36
Disagree a little	20	20
Disagree a lot	14	15
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 375 phase one students, and 2,366 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 10: My teacher is easy to understand

	Phase one	Comparison group
	%	%
Agree a lot	49	53
Agree a little	29	29
Disagree a little	14	11
Disagree a lot	7	6
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 375 phase one students, and 2,366 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

How confident would you feel when doing the following types of activities during maths lessons?

Table 11: If I were asked to draw charts to display my data

	Phase one %	Comparison group %
I would find it very easy	54	54
I would find it easy	35	35
I would find it a little difficult	9	9
I would find it very difficult	2	1
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 374 phase one students, and 2,364 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 12: If I were asked to solve problems using trigonometry

	Phase one %	Comparison group %
I would find it very easy	23	28
I would find it easy	31	31
I would find it a little difficult	34	31
I would find it very difficult	11	9
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 374 phase one students, and 2,364 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012

Table 13: If I were asked to understand indices

	Phase one %	Comparison group %
I would find it very easy	26	28
I would find it easy	33	34
I would find it a little difficult	31	29
I would find it very difficult	10	8
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 374 phase one students, and 2,364 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012

Table 14: If I were asked to represent this relationship in a graph

	Phase one %	Comparison group %
I would find it very easy	55	54
I would find it easy	32	31
I would find it a little difficult	10	11
I would find it very difficult	2	3
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 374 phase one students, and 2,364 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 15: If I were asked to solve mathematics problems using what I have learned in more than one mathematics topic…

	Phase one %	Comparison group %
I would find it very easy	22	23
I would find it easy	43	41
I would find it a little difficult	32	30
I would find it very difficult	3	3
No response	1	2
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 374 phase one students, and 2,364 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 16: If I were asked to gather all the information available, and then use it to solve a particular mathematics problem…

	Phase one %	Comparison group %
I would find it very easy	15	18
I would find it easy	43	45
I would find it a little difficult	34	31
I would find it very difficult	6	5
No response	2	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 374 phase one students, and 2,364 comparison group students, gave at east one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

How much do you agree with these statements about learning maths?

Table 17: I usually do well in maths

	Phase one %	Comparison group %
Agree a lot	25	30
Agree a little	47	45
Disagree a little	20	17
Disagree a lot	8	7
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 373 phase one students, and 2,365 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 18: I would like to take more maths in school

	Phase one %	Comparison group %
Agree a lot	20	21
Agree a little	29	29
Disagree a little	29	26
Disagree a lot	20	23
No response	2	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 373 phase one students, and 2,365 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 19: I enjoy learning maths

	Phase one %	Comparison group %
Agree a lot	22	24
Agree a little	37	38
Disagree a little	22	22
Disagree a lot	17	15
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 373 phase one students, and 2,365 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 20: Maths is not one of my strengths

	Phase one %	Comparison group %
Agree a lot	30	27
Agree a little	24	26
Disagree a little	24	25
Disagree a lot	21	20
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100.

A total of 373 phase one students, and 2,365 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 21: I learn things quickly in maths

	Phase one %	Comparison group %
Agree a lot	19	21
Agree a little	37	39
Disagree a little	30	28
Disagree a lot	13	11
No response	1	2
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 373 phase one students, and 2,365 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 22: Maths is boring

	Phase one %	Comparison group %
Agree a lot	17	19
Agree a little	30	27
Disagree a little	29	31
Disagree a lot	23	22
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 373 phase one students, and 2,365 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 23: I like maths

	Phase one %	Comparison group %
Agree a lot	25	26
Agree a little	37	37
Disagree a little	19	19
Disagree a lot	18	16
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 373 phase one students, and 2,365 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 24: Maths is more difficult for me than many of my classmates

	Phase one %	Comparison group %
Agree a lot	16	14
Agree a little	27	23
Disagree a little	35	35
Disagree a lot	20	27
No response	2	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 373 phase one students, and 2,365 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 25: The way we learn maths at Junior Certificate level is harder than maths in primary school

	Phase one %	Comparison group %
Often	72	63
Sometimes	18	23
Rarely	5	7
Never	1	5
No Response	3	2
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 367 phase one students, and 2,361 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

How much do you agree with these statements about maths?

Table 26: I think learning maths will help me in my daily life

	Phase one %	Comparison group %
Agree a lot	38	37
Agree a little	38	42
Disagree a little	17	14
Disagree a lot	6	6
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 372 phase one students, and 2,355 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012

Table 27: I need maths to learn other school subjects

	Phase one %	Comparison group %
Agree a lot	24	24
Agree a little	46	45
Disagree a little	21	23
Disagree a lot	8	7
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 372 phase one students, and 2,355 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 28: I need to do well in maths to get into the university of my choice

	Phase one %	Comparison group %
Agree a lot	52	52
Agree a little	33	31
Disagree a little	11	11
Disagree a lot	3	4
No response	1	2
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 372 phase one students, and 2,355 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 29: I need to do well in maths to get the job I want

	Phase one %	Comparison group %
Agree a lot	39	42
Agree a little	36	34
Disagree a little	19	16
Disagree a lot	5	7
No response	1	2
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 372 phase one students, and 2,355 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Which of these jobs do you think involve doing maths?

Table 30: Engineer

	Phase one %	Comparison group %
Yes	87	89
No	11	9
No Response	2	2
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 371 phase one students, and 2,359 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 31: Doctor

	Phase one %	Comparison group %
Yes	57	57
No	39	39
No Response	4	4
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 371 phase one students, and 2,359 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 32: Sales Assistant

	Phase one %	Comparison group %
Yes	87	88
No	10	10
No Response	4	2
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 371 phase one students, and 2,359 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 33: Scientist

	Phase one %	Comparison group %
Yes	87	89
No	10	9
No Response	3	2
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 371 phase one students, and 2,359 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

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Table 34: Working with technology

	Phase one %	Comparison group %
Yes	81	82
No	15	15
No Response	4	3
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 371 phase one students, and 2,359 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 35: Accountant

	Phase one %	Comparison group %
Yes	94	95
No	3	3
No Response	3	2
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 371 phase one students, and 2,359 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 36: Nurse

	Phase one %	Comparison group %
Yes	37	37
No	58	57
No Response	6	5
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 371 phase one students, and 2,359 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 37: Dietician

	Phase one %	Comparison group %
Yes	45	51
No	50	45
No Response	6	4
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 371 phase one students, and 2,359 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Table 38: Fashion Designer

	Phase one %	Comparison group %
Yes	48	49
No	47	46
No Response	5	4
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 371 phase one students, and 2,359 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

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Table 39: Owning my own business

	Phase one %	Comparison group %
Yes	95	96
No	3	2
No Response	2	2
Total	100	100

Due to rounding percentages may not sum to 100.
A total of 371 phase one students, and 2,359 comparison group students, gave at least one response to these questions.
Source: NFER survey of Junior Certificate student attitudes, Spring 2012.

Leaving Certificate

How often do you do these things in your maths lessons?

Table 40: We show our working to justify our answers

	Phase one %	Non-phase one %
Often	79	83
Sometimes	18	13
Rarely	1	2
Never	1	0
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100
A total of 299 phase one students, and 1,991 non-phase one students, gave at least one response to these questions.
Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 41: We set goals and targets about our maths learning

	Phase one %	Non-phase one %
Often	22	21
Sometimes	41	39
Rarely	26	26
Never	10	12
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 299 phase one students, and 1,991 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

How much do you agree with these statements about your maths lessons?

Table 42: My teacher sets me work to suit my abilities and interests

	Phase one %	Non-phase one %
Agree a lot	14	16
Agree a little	41	39
Disagree a little	24	26
Disagree a lot	20	19
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,996 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 43: My teacher gives me work that will challenge me to improve my skills

	Phase one %	Non-phase one %
Agree a lot	55	50
Agree a little	36	40
Disagree a little	7	7
Disagree a lot	2	3
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,996 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 44: I know what my teacher expects me to do

	Phase one %	Non-phase one %
Agree a lot	61	57
Agree a little	28	33
Disagree a little	8	7
Disagree a lot	2	2
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,996 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 45: My teacher helps me to understand if I am finding something difficult during a maths lesson

	Phase one %	Non-phase one %
Agree a lot	67	67
Agree a little	23	22
Disagree a little	7	7
Disagree a lot	3	3
No response	0	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,996 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 46: My teacher thinks I can do well in maths

	Phase one %	Non-phase one %
Agree a lot	49	51
Agree a little	39	37
Disagree a little	7	8
Disagree a lot	3	3
No response	1	2
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,996 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 47: My teacher will decide if I should do Foundation Level, Ordinary Level or Higher Level

	Phase one %	Non-phase one %
Agree a lot	12	11
Agree a little	22	20
Disagree a little	25	24
Disagree a lot	40	44
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,996 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012

Table 48: My teacher explains maths in ways that make it interesting

	Phase one %	Non-phase one %
Agree a lot	24	21
Agree a little	35	39
Disagree a little	25	24
Disagree a lot	14	15
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,996 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012

How confident would you feel when doing the following types of activities during maths lessons?

Table 49: If I were asked to work out the probability of something happening

	Phase one %	Non-phase one %
I would find it very easy	42	43
I would find it easy	37	37
I would find it a little difficult	16	16
I would find it very difficult	3	3
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,996 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 50: If I were asked to draw charts to display my data

	Phase one %	Non-phase one %
I would find it very easy	59	57
I would find it easy	32	34
I would find it a little difficult	8	7
I would find it very difficult	0	1
No response	1	2
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,996 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 51: If I were asked to solve problems using trigonometry

	Phase one %	Non-phase one %
I would find it very easy	27	29
I would find it easy	32	31
I would find it a little difficult	30	29
I would find it very difficult	10	10
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,996 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 52: If I were asked to solve problems using the properties of different shapes

	Phase one %	Non-phase one %
I would find it very easy	23	24
I would find it easy	33	38
I would find it a little difficult	36	31
I would find it very difficult	6	6
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,996 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 53: If I were asked to understand indices

	Phase one %	Non-phase one %
I would find it very easy	19	22
I would find it easy	31	35
I would find it a little difficult	38	32
I would find it very difficult	12	8
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,996 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 54: If I were asked to use formulae to solve problems in measurement

	Phase one %	Non-phase one %
I would find it very easy	17	23
I would find it easy	36	37
I would find it a little difficult	38	32
I would find it very difficult	8	7
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,996 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 55: If I were asked to solve problems based on real-life situations

	Phase one %	Non-phase one %
I would find it very easy	29	35
I would find it easy	43	45
I would find it a little difficult	23	16
I would find it very difficult	4	3
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,996 non-phase one students, gave at l east one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 56: If I were asked to gather all the information available, and then use it to solve a particular maths problem

	Phase one %	Non-phase one %
I would find it very easy	8	14
I would find it easy	42	43
I would find it a little difficult	40	36
I would find it very difficult	7	5
No response	2	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,996 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 57: If I were asked to solve maths problems using what I have learned in more than one maths topic

	Phase one %	Non-phase one %
I would find it very easy	15	17
I would find it easy	36	39
I would find it a little difficult	42	38
I would find it very difficult	6	5
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,996 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

How much do you agree with these statements about your maths lessons?

Table 58: I usually do well in maths

	Phase one %	Non-phase one %
Agree a lot	20	22
Agree a little	48	47
Disagree a little	22	21
Disagree a lot	9	9
No response	0	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,995 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012

Table 59: Maths is more difficult for me than many of my classmates

	Phase one %	Non-phase one %
Agree a lot	13	13
Agree a little	23	25
Disagree a little	38	36
Disagree a lot	26	26
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,995 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012

Table 60: I enjoy learning maths

	Phase one %	Non-phase one %
Agree a lot	18	19
Agree a little	34	37
Disagree a little	27	23
Disagree a lot	20	20
No response	0	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,995 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012

Table 61: Maths is not one of my strengths

	Phase one	Non-phase one
	%	%
Agree a lot	33	32
Agree a little	24	26
Disagree a little	26	24
Disagree a lot	16	17
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,995 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012

Table 62: I learn things quickly in maths

	Phase one	Non-phase one
	%	%
Agree a lot	13	17
Agree a little	43	39
Disagree a little	29	30
Disagree a lot	14	14
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,995 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 63: Maths is boring

	Phase one	Non-phase one
	%	%
Agree a lot	24	24
Agree a little	26	25
Disagree a little	30	30
Disagree a lot	19	20
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,995 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 64: I like maths

	Phase one %	Non-phase one %
Agree a lot	19	21
Agree a little	35	37
Disagree a little	22	20
Disagree a lot	23	21
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,995 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 65: The way we learn maths at Leaving Certificate Level is the same as how we learned maths for the Junior Certificate

	Phase one %	Non-phase one %
Often	12	21
Sometimes	30	39
Rarely	29	24
Never	26	14
No response	2	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 299 phase one students, and 1,995 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

How much do you agree with these statements about maths?

Table 66: I think learning maths will help me in my daily life

	Phase one %	Non-phase one %
Agree a lot	16	23
Agree a little	50	43
Disagree a little	21	22
Disagree a lot	11	10
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 297 phase one students, and 1,988 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 67: I need maths to learn other school subjects

	Phase one %	Non-phase one %
Agree a lot	14	13
Agree a little	38	36
Disagree a little	26	30
Disagree a lot	21	20
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 297 phase one students, and 1,988 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 68: I need to do well in maths to get into the university of my choice

	Phase one %	Non-phase one %
Agree a lot	38	39
Agree a little	29	30
Disagree a little	21	16
Disagree a lot	11	14
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 297 phase one students, and 1,988 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 69: I need to do well in maths to get the job I want

	Phase one %	Non-phase one %
Agree a lot	19	23
Agree a little	32	30
Disagree a little	27	25
Disagree a lot	21	21
No response	1	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 297 phase one students, and 1,988 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Which of these jobs do you think involve doing maths?

Table 70: Engineer

	Phase one %	Non-phase one %
Yes	95	96
No	3	3
No Response	2	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,990 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 71: Doctor

	Phase one %	Non-phase one %
Yes	68	59
No	28	38
No Response	4	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,990 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 72: Sales Assistant

	Phase one %	Non-phase one %
Yes	88	88
No	10	10
No Response	2	2
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,990 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 73: Scientist

	Phase one %	Non-phase one %
Yes	94	89
No	5	9
No Response	1	2
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,990 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 74: Working with technology

	Phase one %	Non-phase one %
Yes	89	87
No	9	10
No Response	2	2
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,990 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 75: Accountant

	Phase one %	Non-phase one %
Yes	95	96
No	3	2
No Response	2	2
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,990 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 76: Nurse

	Phase one %	Non-phase one %
Yes	46	40
No	50	56
No Response	4	3
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,990 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 77: Dietician

	Phase one %	Non-phase one %
Yes	60	56
No	37	41
No Response	3	3
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,990 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 78: Fashion Designer

	Phase one %	Non-phase one %
Yes	45	45
No	52	51
No Response	3	4
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,990 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 79: Owning my own business

	Phase one %	Non-phase one %
Yes	94	96
No	3	2
No Response	3	1
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 1,990 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 80: Are you currently thinking of going on to further study when you finish your Leaving Certificate?

	Phase one %	Non-phase one %
Yes	91	91
No	5	6
No response	5	3
Total	100	100

Due to rounding percentages may not sum to 100

A total of 298 phase one students, and 2,003 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 81: If yes, please tick the box that best describes the further study you plan to do after finishing your Leaving Certificate

	Phase one %	Non-phase one %
University, doing a course that will involve a lot of maths	12	14
University, doing a course that will involve some maths	37	33
A technical or vocational course that will involve maths	6	6
University, doing a course that won't involve maths	33	35
Other	9	11
No response	4	2
Total	100	100

Due to rounding percentages may not sum to 100
A total of 271 phase one students, and 1,816 non-phase one students, gave at l east one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 82: Other, please specify

	Phase one	Non-phase one
Technical or vocational course that does not include maths	4	14
Post-leaving certificate course/college	8	7
Other - vocational training (e.g. apprenticeship)	16	2
Unspecified further study – medicine and healthcare	4	9
Unspecified further study - sports sciences	0	4
Unspecified further study – music and arts	8	6
Unspecified further study – childcare and education	8	5
Unspecified further study - law and social sciences	0	6
Unspecified further study – science and technology	12	6
Unspecified further study – business and economics	0	4
Unspecified further study - veterinary and animal care	0	2
Unspecified further study- tourism and hospitality	0	4
Unspecified further study – computing and IT	0	1
Unspecified further study - agriculture	4	2
Unspecified further	4	4

study – fashion, hair and beauty		
Unspecified further study - social care	0	1
Unspecified further study - archaeology	4	0
Uncodeable	12	2
No response	16	22
N =	35	200

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 83: Are you currently thinking of doing a job that involves maths?

	Phase one %	Non-phase one %
Yes	34	32
No	60	63
No response	6	4
Total	100	100

Due to rounding percentages may not sum to 100
A total of 299 phase one students, and 2,003 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

Table 84: Other, please specify

	Phase one	Non-phase one
Architecture	2	2
Veterinary	3	1
Physiotherapy	1	1
Biomedical Science	1	0
Science	7	8
ICT/Computer Science/Computing	5	9
Software Development	3	3
Computer Game Design/Development	6	2
Chemical engineering	1	1
Civil engineering	1	1
Engineering (general/unspecified)	4	8
Systems engineering	1	1
Biomedical engineering	1	1
Mechanical engineering	6	5
Structural engineering	1	1
Business/management	11	9
Law	2	0
Finance/Accounting	10	12
Economist	3	1
Teaching (general)	15	11
Teaching (maths)	3	2
Teaching (science)	3	1
Agriculture	1	1
Sound/Audio Visual engineering	2	1
Design engineering	1	1
Psychology	2	1
Military	2	1
Aeronautic engineering	1	1
Marketing	1	1
Medicine/Health Sciences	0	5
Pharmacy/Pharmaceutical Science	0	1
Sports science/fitness	0	2
Electrical engineering	0	2
Hospitality	0	1

Other relevant/vague comment	1	0
Irrelevant/Uncodeable comment	1	2
No response	9	7
N =	101	649

More than one answer could be put forward so percentages may sum to more than 100.

A total of 92 phase one students, and 601 non-phase one students, gave at least one response to these questions.

Source: NFER survey of Leaving Certificate student attitudes, Spring 2012.

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