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# Mind the Gap: An Initial Analysis of the Transition of a Second Level Curriculum Reform to Higher Education

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## Abstract

This paper details an initial analysis of the transition of a second level curriculum reform to higher education in Ireland. The reform entitled 'Project Maths' involved changes to what second level students learn in mathematics, how they learn it and how they are assessed. Changes were rolled out nationally on a phased basis in September 2010. Students who were taught and assessed through the new curriculum first entered third level education in September 2012. It is important that third level mathematics lecturers are aware of the changes to the curriculum since certain topics such as vectors and matrices are no longer taught at second level. Hence third level courses may need to be adapted accordingly. This study investigates mathematics lecturers' awareness of Project Maths and whether they have made any adaptions to their course content, teaching and assessment approaches as a result of the new curriculum being introduced. The findings, from a return rate of 23% of eligible respondents, show that although many lecturers are mindful of the concept of Project Maths, they are not aware of the changes in full and how it affects their own course content, teaching and assessment strategies. Accordingly, the gap between second and third level education remains. This study highlights that more needs to be done to ensure there is coherent and uniform approaches to the teaching, learning and assessment of mathematics in the transition from second to third level education.



**Keywords:** mathematics education, curriculum reform, transition stages


## 1. Introduction

Formal education in Ireland takes place in three stages, primary, post-primary (also referred to as second level) and higher education (also referred to as third level). In recent years low retention rates in STEM (Science, Technology, Engineering, Mathematics) courses at third level have resulted in international concern regarding the transition of students from second level to further education (Bourn, 2007). Much of this concern has focused on the longstanding mathematical under-preparedness of incoming third level students, as issue which is regularly referred to as the 'Maths Problem' (Howson et al., 1995). This phenomenon in which students are under-prepared for the mathematical demands of their undergraduate course, dates back many decades and has been reported in countries such as Ireland (Cleary, 2007; Faulkner et al., 2010), the U.K. (Edwards, 1995; Lawson, 2003), and more recently Portugal (Carr et al., 2015). The 'Maths Problem' is characterised by beginning undergraduates displaying a lack of basic mathematical skills, as well as fragmented understanding, inadequate concept knowledge, and an inability to successfully solve mathematical problems (Rylands & Coady, 2009; Gill, O'Donoghue, Faulkner, Hannigan, 2010).

In Ireland, this under-preparedness of students for third level mathematics has typically been attributed to ineffective second level mathematics education (Gill et al., 2010). Research carried out in 2005 by the National Council for Curriculum and Assessment (NCCA) described mathematics teaching in Ireland as procedural in fashion and highly didactic. There was a formal, behaviourist style evident which consisted of whole class teaching and the repetition of skills and procedures demonstrated by the teacher (Morgan & Morris, 2009). This resulted in students learning the 'how' rather than the 'why' of mathematics (Prendergast & O'Donoghue, 2014) which subsequently led to poor performance at third level (Gill et al., 2010). To combat the 'Maths Problem' in Ireland, significant changes have

been made to the second level mathematics curriculum with the introduction of 'Project Maths'. This reformed curriculum aims to place greater emphasis on student understanding of mathematical concepts, enabling students to relate mathematics to everyday scenarios with increased use of contexts and applications (Prendergast et al., 2014). Project Maths also aims to promote further focus on problem-solving skills and the alignment of assessment with the aforementioned revised classroom practices. Overall the goals of the reform appear strikingly similar to the goals of the change movement led by the National Council of Teachers (NCTM) in the U.S (NCTM, 1991, 2000). Both NCTM and Project Maths call for more real world connections and the use of instructional technology, and both promote an increased emphasis on statistics and probability, algebra, and geometric reasoning.

In summary, Project Maths consists of three main changes, namely what students learn in mathematics, how they learn it and how they will be assessed. The syllabi were rearranged and divided into five main strands (Statistics and Probability, Geometry and Trigonometry, Number, Algebra and Functions and Calculus). As detailed in Table 1, changes began to be rolled out nationally on a phased basis in September 2010 with different strands being introduced each year and subsequent adaptations being made to the assessment in state examinations. Differences in the nature of the assessment pre and post reform can be found in the exam material archive of the State Examinations Commission website (www.examinations.ie). Strands 1 and 2 of the revised syllabi were first examined at senior cycle (upper second level) in all schools nationally in June 2012. Hence students who had encountered Project Maths first entered third level education in September 2012. The phased implementation means that for each consecutive year after 2012, students have entered third level after being examined on more and more of the reformed syllabi. In 2014, students entering third level would have been examined on all five strands of Project Maths in their second level state examinations.

**INSERT** Table 1: Project Maths Implementation Timeline

While it is early to evaluate the success of the curriculum reform at second level, an interim report has found that there is emerging evidence of the positive impacts of Project Maths on students' experiences of, and attitudes towards, mathematics (Jeffers et al., 2013). Furthermore, students' have been found to achieve more at individual strand level (Jeffers et al., 2013). However despite these early positives, there is also evidence to suggest that the reform is not having the desired effect at third level. Research carried out by Treacy and Faulkner (2015) and Prendergast and Treacy (2015) has found that the transition to the new curriculum has coincided with a further decline of basic mathematics skills which are required in higher education. Additionally there are anecdotal claims of negative attitudes and ambiguity towards the reform amongst third level mathematics lecturers (The Irish Times, June 2015).

Research has found that such transitional issues between secondary and tertiary mathematics education are common place and involve a whole spectrum of problems and difficult situations (Kajander & Lovric, 2005; Clark & Lovric, 2008). Guzman et al. (1998, p.748) identified this transition point as "a major stumbling block in the teaching of mathematics". A number of significant changes occur at this point including variations in teaching and learning styles and the type of mathematics being taught (Hong et al., 2009). There may also be disparities in approaches to thinking about mathematics at secondary and tertiary levels. Tall (2008) suggests that as students' progress from secondary to tertiary mathematics, their thinking must move from a symbolic world to a more formal world. However if tertiary

courses are trying to build thinking in the formal world with students who are primarily symbolic thinkers, then difficulties will arise (Hong et al., 2009). Undoubtedly there are important roles for secondary teachers and tertiary lecturers in helping students to ease these difficulties. However large scale research carried out in New Zealand has shown that there is a lack of communication between these two sectors and a lack of knowledge and awareness of what is happening in each other's courses (Hong et al., 2009). This study will investigate such findings from an Irish perspective and evaluate third level mathematics lecturers' awareness of and attitudes to the recent changes to the second level mathematics curriculum brought about by Project Maths.

## 2. Methodology

The aim of this study is to carry out an initial analysis of the transition of a second level curriculum reform to higher education in Ireland. The methodology involved the distribution of a mixed methods questionnaire to mathematics lecturers in Irish Higher Education Institutes (HEIs). The questionnaire investigated third level mathematics lecturers' awareness of Project Maths and whether there have been any adaptions to course content, teaching and assessment approaches as a result. The intention was to gather data from mathematics lecturers in national HEIs to answer the following research questions:

1) Are third level mathematics lecturers familiar with the changes that Project Maths has made and have they adapted any of their modules at third level to reflect the changes to the curriculum at second level?

2) How do lecturers characterise incoming third level students in each of the five strands compared to those who had been taught and examined using the traditional curriculum?

3) Did third level lecturers receive any formal professional development regarding the mathematics curriculum reform at second level and do they think they should receive such professional development?

4) What is the level of support / opposition to Project Maths amongst third level mathematics lecturers?

### 2.1 The Instrument

The authors decided to use a mixed method questionnaire which combined both quantitative and qualitative methods of research. This questionnaire was designed by the authors and consisted of twelve questions, including a mixture of dichotomous questions, rating scales and open ended questions. The questions looked to gather information on a range of matters in relation to third level lecturers' awareness of Project Maths. For example in the first three questions participants were asked to indicate how familiar they were with any changes to the syllabus, teaching approaches and assessment at second level. They were also asked to describe any of the changes which they were familiar with and outline any modifications that they had made to reflect these changes in their own course work. Prior to distribution, the questionnaire was piloted with five experienced mathematics lecturers who offered advice regarding its layout and structure and the wording of some questions. Similar to the initial stages of any reform, Project Maths has provoked much reaction, both positive and negative. For the purpose of this study the authors were cautious to stress that the reform is still in its infancy and that the main purpose of this study was not to condemn or endorse the changes, but to investigate how they were transitioning to third level. This important point was made clear in the cover letter accompanying the questionnaire. The finalised version of the

questionnaire was then transcribed into Google forms and circulated via email to mathematics departments in HEIs around the country in September 2015. The lecturers would have received the questionnaires at the same time as the second full cohort of students who were examined on all five strands of Project Maths entered third level.

**2.2 Data Analysis**

The quantitative data from the questionnaires was analysed using Statistical Package for Social Sciences (SPSS) (Version 22.0). The method of qualitative data analysis used was based on Grounded Theory. This form of analysis, which was developed by Barney Glaser and Anselm Strauss in the late 60's, involves theory emerging from the data rather than the other way around (Glaser & Strauss 1967). Coding was used to reveal the major themes and sub-themes which existed in the data. The coding involved disassembling the data and rearranging the fragments to provide an understanding that explored similarities and differences across responses in relation to the four main research questions (Ezzy 2013). The lecturers' responses were colour-coded independently by three of the authors, highlighting themes and sub-themes until the coding was complete. The different sets of themes and sub-themes were then compared by all authors to increase comprehensibility and to provide sound and consistent interpretation of the data. Such comparison confirmed that the authors did not have pre-conceived ideas of what would emerge from the data as all three sets of analysis revealed very similar results.

**2.3 Respondents:**

A total of 46 mathematics lecturers responded to the questionnaire. Higher education in Ireland is provided mainly by seven universities, fourteen institutes of technology (IoTs) and seven colleges of education (Hunt, 2011). The lack of distinct mathematics departments in some Irish third level institutes means that the total number of mathematics lecturers in Ireland is difficult to obtain. However a headcount of staff in institutes that have mathematics departments yields a total of 204 lecturers. Viewing this as the population of mathematics lecturers in Ireland, the response rate for this study can be estimated as being 23%.

With regard to the type of institute, over half (25) of those who responded were university mathematics lecturers. Three selected the 'Other' option. These were most likely lecturing in colleges of education or other state aided institutions such as the National College of Ireland. The data also shows that forty of respondents were full time mathematics lecturers. There were six part time lecturers, three of whom were based in IoTs.

In terms of other demographics, the majority of the responding lecturers were male (72%) and aged 51 – 60 years old (39%). The majority of the female respondents were in the 31 – 40 age bracket (54%). These findings are comparable to a recent London Mathematical Society (LMS) report which similarly demonstrated a gender imbalance for mathematicians employed in HEIs in the UK, with women representing just 17.5% of academic staff in mathematics departments (McWhinnie & Fox, 2013). In line with this study's findings, the LMS report also found that female academic staff in mathematics departments were on average younger than their male counterparts.

**3. Findings**

As mentioned previously, the questionnaire consisted of twelve questions and each of these corresponded with specific research questions. Both the qualitative and quantitative findings of the study were divided into relevant sections in relation to the research questions and analysed and discussed together.

### 3.1 Familiarity with the Changes of Project Maths and Adaptations Made

In the first section of the questionnaire lecturers were asked to indicate their level of familiarity with any changes brought about by the reform and to detail specific changes which they were familiar with. They were also asked to specify whether they had adapted any of their modules at third level to reflect the changes made to the curriculum at second level.

As mentioned previously there were three main changes brought about by Project Maths, namely changes to what mathematical content is taught, how it is taught and how it is assessed. Figure 1 shows that mathematics lecturers at third level became less and less familiar as they moved through these three changes. For example 11% of respondents stated that they were not at all familiar with changes to the syllabus. This figure rose to 28% for teaching approaches and 47% for assessment.

**INSERT** Figure 1: Third Level Lecturers' Familiarity with Reform at Second Level

Similar findings regarding familiarly were reported in the qualitative data for each of the three changes:

***Syllabus:*** 38 lecturers provided details of the syllabus changes that they were familiar with. The following themes emerged from their responses, starting with the most common:

- *Removal of Integration/ Less Calculus*
- *Increased Emphasis on Statistics and Probability*
- *Emphasis has changed from Rote Learning to Problem Solving, Context/Applications focussed with Real Understanding of Mathematics at the Core*.
- *Introduction of Euclidean Geometry*
- *Changes to the Structure of the Syllabus*
- *No Options in the Exam*.

All of these themes are legitimate changes as set out by the curriculum documentation.

***Teaching Approaches:*** 30 lecturers provided details of any changes to teaching approaches that they were familiar with. The majority of these mentioned some or all of the following observations:

- *Reduction in prescriptive material, procedure focus, didactic/traditional teaching*
- *Increased emphasis on problem based learning, teaching for understanding, active learning and applications and context.*

These responses demonstrate that many of the lecturers are knowledgeable in the changes made to the teaching approaches brought in by the new curriculum. One respondent was familiar with how the teaching approaches being implemented were intended to place an emphasis "on horizontal interactions with other school subjects and to support Junior Cycle Key Skills and Literacy and Numeracy Strategy". This is one of aims of the new curriculum (Project Maths Development Team, 2015).

**Assessment Approaches:** 22 lecturers provided details of the changes to assessment approaches that they were familiar with and four common themes emerged:

- *Examination Questions are no Longer Predictable*
- *Questions Examined are More Context Focussed*
- *Marking Scheme has changed to Reward Conceptual Understanding*
- *Changes to the Format of the Assessment Paper*

The decreasing familiarity with each of the three changes is also reflected in the adaptations that lecturers have made to their own modules at third level (see Figure 2).

**INSERT** Figure 2: Changes made at Third Level in Response to Project Maths

Lecturers were most familiar with changes made to the syllabus and as a result 39% have made changes to their own course content at third level. Three main changes that lecturers have made emerged in the qualitative data:

- *Introduced Matrices/Vectors/Calculus from a more Basic/Beginners Level*
- *Changed the Focus of their Lectures to Problem Solving/Applications of Mathematics*
- *Increased the Level of Difficulty at which they pitch their statistics and probability Modules*

Less than half the number of lecturers who made changes to their course content, made changes to their teaching approaches (16%). One main theme emerged from the qualitative responses detailing this change:

- *Teach the Material Slower and Include more Foundation Material*

Lecturers were least familiar with changes made to assessment approaches and this was reflected by 11% of lecturers making any such changes at third level. Two common themes emerged from the qualitative data describing these changes:

- *Effort to Include more Context/Realistic Maths Education*
- *Focus on testing both Procedural and Conceptual Understanding*

### 3.2 Lecturers Characterisation of Incoming Students

Although the reform is at an early stage, lecturers were asked to compare how they would describe incoming third level students who have been taught and examined using the Project Maths curriculum compared to those educated using the traditional curriculum in each of the five strands of the reformed curriculum.

**INSERT** Figure 3: Traditional Curriculum versus Project Maths – Five Strands

As evidenced in Figure 3 many respondents were unsure at this early stage of how students of the different curriculums compared. However the data did show that 16% of respondents felt that students of Project Maths were better at ‘Geometry and Trigonometry’ and 21% felt they were better or much better at ‘Statistics and Probability’. It is worth noting these are the two strands that were first phased in and the first students who would have been taught and assessed through Project Maths in these strands would have entered third level in September 2012. Thus these are the strands that third level lecturers have had the longest time to compare students. On the other hand 19% of lecturers felt that their students were worse or much worse at ‘Number’, 21% felt they were worse or much worse at ‘Algebra’ and 35% felt they were worse or much worse at ‘Functions and Calculus’. It must be pointed out that the ‘Functions and Calculus’ strand was the final strand of Project Maths to be phased in and so the lecturers could only refer to one cohort of students for reference. However this decline in calculus ability of incoming students was also mentioned in a number of responses in the qualitative data with one respondent noting that this knowledge gap “has massive knock-on effects for applied maths and physics education at third level”.

### 3.3 Professional Development

Lecturers were asked whether they had received any formal professional development regarding Project Maths and to specify who it was from and what it entailed. If they had not received any, they were asked to detail how they became knowledgeable on the reform. 83% of respondents stated that they had not received any form of professional development. In the qualitative data the majority of these respondents noted that they had *Obtained the Knowledge Themselves.* This was done in a variety of ways, for example:

- *Through Own Research*: "read information published by the department",
- *Engagement with Secondary Schools:* "I used to help students in a pilot school" or "My daughter is doing the course now".

Some respondents noted that they had *Attended Presentations on Project Maths*. However very few stated explicitly that these presentations were organised by their Institution/Department. One respondent attended talks that "were running to inform parents about the changes".

Lecturers were also asked whether they felt they should receive professional development regarding curriculum reform at second level. 41% of respondents felt that third level lecturers should not receive any such development. This opinion is best summed up in the qualitative data through the following response:

> "To be honest, I don't think even if there was formal professional development offered, that many lecturers would attend. Most lecturers would be comfortable in just reading up about any curriculum changes once they were directed to the appropriate reading material"

On the other hand, 59% of lecturers stated that they do believe that lecturers should receive professional development and in the qualitative data some respondents stressed the importance of third level lecturers having *Accurate and up-to-date Knowledge of the Secondary Curriculum*.

> "In order to cater for incoming students, we need to know in detail what the approach used in second level is. We won't be able to understand what our students think if we don't know where they are coming from"

Some suggestions on what this professional development could entail included "once-off talks or brief workshops at all third level institutions".

### 3.4 Support or Opposition to the Reform

The questionnaire finished by asking the lecturers to specify their level of support or opposition to the reform and also to outline the most positive and negative aspects of the reform in their opinion. As evidenced in Figure 4, the views regarding the reform were split with 42% of lecturers asserting that they were in opposition and 33% declaring that they were in favour.

**INSERT** Figure 4: Level of Opposition / Support for the Reform amongst Third level Lecturers

The two main themes which emerged from responses in support of the reform were the potential to *Increase Student Understanding* and the opportunity for a *Reform of the Teaching Methods used in Mathematics Classrooms*. Of those who expressed reservations about the reform, the main theme was the *Loss of Content and Rigour* at second level. Another reservation was the concern that the *Reform of the Teaching Methods would not happen.*

With regards to the most positive and negative aspects of the reform, the majority of respondents felt that the move from *Rote Learning to Problem Based Learning* and the

subsequent *Increase in Understanding* is a major positive. A small number expressed their satisfaction with the *Increase in the Amount of Statistics and Probability*. Of those who identified negative aspects to the reform, the dominant theme was the *Removal of Core Material*.

> "Students having no exposure to matrices, integration etc. and having a poor grounding in calculus, means that first year maths at third level has a dramatically increased amount of material to cover, including many completely new concepts"

In addition a few contributors felt the *Reform was Introduced Too Fast* and that the overall *Implementation was Poor* with teachers not receiving sufficient preparation.

## 4. Discussion

This discussion will address each of the four research questions in light of the findings and the existing literature in the field.

### 4.1 Are third level mathematics lecturers familiar with the changes that Project Maths has made and have they adapted any of their modules at third level to reflect the changes to the curriculum at second level?

Large scale research in New Zealand has shown that there is a lack of knowledge and awareness by secondary teachers and tertiary lecturers of what is happening in the other sector's courses (Hong et al., 2009). This problem is undoubtedly exacerbated in times of curriculum reform. For example Kajander & Lovric (2005) found that lecturers are often unaware of or unwilling to accept changes at second level. In the study carried out by the authors the quantitative data showed that lecturers at third level became less and less familiar as they moved through these three main changes of Project Maths. For example 40% stated that they were somewhat familiar with changes to the syllabus. This figure fell to 20% for teaching approaches and 5% for assessment. The qualitative responses indicate that some lecturers were quite well informed of the changes which have been made to the syllabus, with many being familiar with the changes in content (reduction/increase in material in particular subject areas) and a smaller proportion detailing the change in emphasis from rote learning to teaching for understanding. Many lecturers were also aware of the main changes to the teaching approaches under the new reform and some of them mentioned what the NCCA summarise as the most significant adjustments in this respect.

> "There is more of an emphasis on understanding of the concepts. Students encounter maths in context, and investigate and explore mathematical ideas. Active methodologies are used to promote students engagement in mathematics classes and to provide insights into mathematics and its applications" (NCCA, www.ncca.ie).

Despite 47% of the lecturers stating that they were not at all familiar with changes to the assessment, as a group they hit on many of the key points in the qualitative data as outlined by the NCCA. However while many of the responses referred to the summative examination, there was no reference made to the types of formative assessment that should now be present in the Project Maths classroom such as higher order questions, investigation reports, oral explanations etc. (Department of Education and Skills, 2013)

In terms of making changes at third level in response to Project Maths, 39% of lecturers have made content changes to mathematics modules. However in the majority of cases these changes have come in the form of a reduction in the volume of assumed pre-requisite knowledge. The quantitative data showed that just 16% of lecturers have made changes to their teaching approaches and 11% to their assessment approaches. These low figures are

undoubtedly linked to the fact that many lecturers are unfamiliar with the changes to the teaching and assessment approaches brought about by Project Maths. If lecturers are unfamiliar with the reform, it is unlikely that they will make changes in response to it.

### 4.2 How do lecturers characterise incoming third level students in each of the five strands compared to those who had been taught and examined using the traditional curriculum?

There were some noteworthy findings to this question in both the quantitative and qualitative data. 21% of respondents felt that students were better or much better at 'Statistics and Probability' in Project Maths in comparison to those who had studied the old curriculum. This finding is somewhat expected as the most significant change in the syllabi for both Junior Certificate and Leaving Certificate mathematics according to the NCCA (www.ncca.ie) is the increase in the amount of statistics and probability studied and the increased emphasis on student understanding of these concepts. On the other hand 35% of lecturers felt that students were now worse or much worse at 'Functions and Calculus'. This may be a result of the reduced amount of differential calculus on the reformed syllabus and the almost complete removal of integration.

### 4.3 Did third level lecturers receive any formal professional development regarding the mathematics curriculum reform at second level and do they think they should receive such professional development?

In the quantitative data 83% of respondents stated that they had not received any professional development. The data revealed a wide variety of alternative sources of knowledge on the reform ("My own children", "Common room gossip", "My own research", Media"). 41% of respondents felt that it was not necessary for third level lecturers to receive professional development regarding the curriculum reform. This finding highlights the broader issue of why some third level lecturers are hesitant to engage in professional development. Its provision is a central component to effective teaching and has been a highly topical issue in second level education for many years (Smith, 2004). Until recently, third level lecturers have not been subjected to the same scrutiny and evaluation of their teaching as their second level counterparts (Hounsell, 2003). Indeed some academics have regarded any such measures as an affront to their academic autonomy and an unwarranted deference to student opinion (Hounsell, 2003). However the growth in participation in higher education in recent years and measures to widen access are bringing students into the third level system from a broad spectrum of ability and from diverse backgrounds (Horgan, 2003). These factors present an enormous challenge to third level lecturers who are expected to 'combine the talents of scholar, writer, producer, comedian, showman and teacher in ways that contribute to student learning' (McKeachie, 1994). Incentives must be put in place to encourage lecturers to engage in professional development initiatives which will ensure they can rise to this challenge.

### 4.4 What is the level of support/opposition to Project Maths amongst third level mathematics lecturers?

There were some strong views forthcoming in relation to this question with 42% of lecturers asserting that they were in opposition and 33% declaring that they were in favour. Again the qualitative data enabled this information to be interpreted further. Many lecturers agreed that "something needed to be done" and felt that the changes are "well-intentioned". There were many positive references to the promotion of problem solving and a more "inquisitive culture

in the classroom" as well as moving away from rote learning and "placing a renewed national focus on mathematics". However there were also many concerns. These included concerns surrounding the "omission of some topics" and the "dumbing down" and "dilution" of the syllabus. While there are some valid arguments for and against, the authors submit that the reform needs more time to embed fully in the system and at this stage it is too early to pass solid judgement. The phased introduction of the reform means that, although students who have been taught and assessed through Project Maths first entered third level in 2012, it will be 2017 before the first cohort of students, who have experienced all five strands of Project Maths throughout their entire second level education, will enter third level.

## 5 Conclusion

An Irish study conducted by McCoy (2014) found that 80% of students reported significant differences in approaches to teaching and learning mathematics between second and third level education. More recent research conducted by the Higher Education Authority in Ireland has called for a better transition for second level students to higher education (HEA, 2015). The introduction of Project Maths has been introduced as one means of improving the transition and equipping students with the necessary skills to cope with the demands and nature of mathematics education in third level (NCCA, www.ncca.ie). However the findings of this study highlight that this may not presently be the case with 42% of lecturers asserting that they were in opposition and some expressing concern regarding the "omission of some topics" and the "dumbing down" and "dilution" of the syllabus.

Students who have been taught and assessed under the reformed curriculum have been entering third level education since September 2012. Despite this, 61% of the third level mathematics lecturers surveyed stated that they were either not at all familiar or slightly familiar with changes to teaching approaches brought about by recent second level reform. This figure rose to 69% for assessment approaches. While second level mathematics teachers are receiving intensive professional development and retraining on how to modify their teaching methods, course content and assessment strategies, third level mathematics lecturers have not been catered for, with 41% of them believing they should not be catered for. The findings show that although many lecturers are mindful of the concept of Project Maths, they are not aware of the changes in full and how it affects their own course content, teaching and assessment strategies.

The HEA (2015) report details that the transitional issues which second level students are reported to have upon entry to higher education lie with the stakeholders in second level education. However, the authors concur with the findings of Hong et al. (2009) who suggested that there are important roles for secondary teachers and tertiary lecturers to play in helping students with their transition. While higher education should not be a mere extension of second level education, there is a need for both teachers and lecturers to be aware of what is happening in each other's sectors to ensure a coherent approach to mathematics education in the transitionary stages. One aspect of increasing this awareness is the need for closer communication between teachers and tertiary lecturers and their institutions, to include understanding of the unique nature of teaching and learning in each sector. However, this interaction will occur only when, according to one lecturer in Hong et al.'s (2009) study, there is 'greater sharing between the two groups [teachers and tertiary educators] and awareness of what is being done in each other's areas'. This will require a commitment to professional development from both sectors (Hong et al., 2009).

The authors feel that this study makes an important contribution to the field. The amount of research in mathematics education at the tertiary level is still modest (Selden & Selden, 2001), and very few studies have focused on the secondary tertiary transition (Clark & Lovric, 2008). However, it is not without its limitations. The changes brought about by

Project Maths are still very much in their infancy. It will be 2017 before the first cohort of students, who have experienced all five strands of Project Maths throughout their entire second level education, will enter third level. Only then will third level lecturers be able to accurately compare incoming students who were taught through the reformed curriculum in comparison to the traditional curriculum. The authors plan to conduct further research in this area when such time has elapsed. In the meantime, we aim to be at the forefront locally in helping to bridge the gap between the secondary and tertiary sectors through raising awareness of the nature of mathematics education at both levels.

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