

Quality Assurance / Quality Improvement  
Programme for Academic Units

Peer Review Group Report  
for the

Maths Department

St Patrick's College Drumcondra  
Dublin 9

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Professor Doron Zeilberger

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## Introduction

This Quality review has been conducted in accordance with a framework model developed and agreed through the Irish Universities Quality Board (IUQB) and which complies with the provisions of Section 35 of the Universities Act (1997). The model consists of a number of basic steps.

1. An internal team in the Department being reviewed completes a detailed self-assessment report (SAR). It should be noted that this document is confidential to the Department and to the Review Panel and to senior officers of the College
  2. This report is sent to a team of peer assessors, the Peer Review Group (PRG) – who then visit the Department and conduct discussions with a range of staff, students and other stakeholders.
  3. The PRG then writes its own report
  4. The Department produces a response, in consultation with the Head of Department, in response to the various issues and findings of the SAR and PRG Reports.
  5. The PRG Report and the Department response are then considered at a meeting of the relevant Senior Management of the College (President, Registrar etc.) who address recommendations in the Peer Review Group Report, that fall outside the control of the Department or that require additional resources. Arising from this meeting, Department and College based action plans are approved. Together, these are termed the Quality Improvement Plan (QuIP)
  6. A summary of the Quality Review is sent to the Governing Authority of the College, who may approve publication in a manner that they see fit. Following the approval of the summary report by the Governing Authority, it is published on the College website. The full text of the Peer Review Group Report is also published on the Quality Promotion Unit website.
- **This document is the report referred to in Step 3 above. It is important to remember that the full text of this report will become a public document.**

## Review Group Report

### 1. Profile of the Department

#### Location of the Unit

Staff offices are located in room number E213 (Dr. John Cosgrave), B127 (Dr. Sinéad Breen) and Merville 29 (Dr. Maurice O'Reilly). Mathematics lectures are generally held in rooms D204 and D205. Some B.A. seminars take place in Dr. Cosgrave's office. All computers in the college have Maple software (licensed for fifty users) and priority is given to Maple users in room D305.

#### Staff

There are three full-time staff members, Dr. John Cosgrave (head of department), Dr. Sinéad Breen and Dr. Maurice O'Reilly. No part-time staff members are employed. However, third year mathematics students do facilitate some tutorial sessions.

## Product / Processes

The Department of Mathematics offers programmes in mathematics to students of both the B.A and B.Ed programmes. Students take courses in algebra, analysis, number theory and statistics. Use is made of computer software such as Maple and Excel.

### **2. The Self-Assessment Process**

The Co-ordinating Committee consisted of

Dr. John Cosgrave

Dr. Sinéad Breen

Dr. Maurice O'Reilly

### **3. The Peer Review Group Process**

#### Site Visit Programme

The visit of the Peer Review Group (PRG) took place on the 12<sup>th</sup> and 13<sup>th</sup> February 2007. Dr. Mary Shine Thompson, Dean of Humanities, welcomed the group and a briefing was given by Dr. Daire Keogh, Quality Promotion Co-ordinator. On the morning of the 12<sup>th</sup> February, the Peer Review Group (PRG) gave consideration to the self-assessment report. Professor Tom Laffey was appointed as chair and Thérèse Dooley was appointed as rapporteur of the PRG.

Over the course of these two days the group met with the following:

- A representative group of mathematics students (selected from 1<sup>st</sup> year, 2<sup>nd</sup> year and 3<sup>rd</sup> year students of the B.A. and B.Ed programmes);
- Two 2<sup>nd</sup> year B.Ed students who had taken mathematics as an academic subject in first year but who did not choose it as their academic subject in second year.
- The president of the Students' Union, Shaun Conaughan
- Dr. John Cosgrave
- Dr. Sinéad Breen
- Dr. Maurice O'Reilly
- Members of college administration (President, Registrar and Secretary/bursar).

Included in the programme was a tour of the department facilities, i.e., rooms D203 and D204, the computer laboratory, office and notice board space.

On the afternoon of the 13<sup>th</sup> February, the PRG prepared a draft report. The Chair, Professor Tom Laffey, made an exit presentation at which members of the Mathematics Department, the Quality Promotion Co-ordinator (Dr. Daire Keogh), the Quality Promotion Administrator (Ms. Sharon King) and the PRG were present.

#### Methodology

All three members of the PRG collaborated on consideration of the self-assessment report and on the preparation of the draft report. They conducted all interviews jointly. Dr. John Cosgrave brought two members of the PRG (Professor Tom Laffey and Professor Doron Zeilberger, both of whom are external to SPD) on a tour of the campus and of the teaching rooms. All three members viewed the computer facilities and office space.

## Overview of the Site Visit

All those interviewed as part of the PRG visit were most gracious and helpful. They showed a great willingness to share information and to assist in the quality review process.

Lecturers and students showed great enthusiasm for their tasks. Of main concern is the low uptake of mathematics in 2<sup>nd</sup> year.

Students commented on the challenging nature of mathematics in the context of the heavy load of the B.Ed programme in particular. Indeed the exceptionally heavy workload experienced by students was also mentioned by college administration. However, mathematics is a subject that is seen as more demanding than other academic subjects. This is a primary factor in the decisions by students not to select the subject as one of their academic subjects in second year.

In general, the timetable provided for the peer review visit was suitable although interviews with staff members may have been afforded more time.

## Comments on the Site Visit

The visit was a positive and educative experience for all members of the PRG. The comprehensive self-assessment report combined with feedback from a broad range of relevant persons were most helpful in providing the PRG with insight into the nature of the mathematics department.

## Methodology

Sources of information included the self assessment report, websites of the mathematics department, interview responses and information gleaned from the visit to the unit. Thérèse Dooley who is a staff member of SPD was able to provide a briefing on the nature of the B.Ed and B.A. programmes, the entry requirements etc. All three members of the PRG discussed each item of the report and prepared the draft report jointly towards the end of the two day visit. The rapporteur (Thérèse Dooley) compiled the next draft of the report and sent copies via email to Professor Tom Laffey and Professor Doron Zeilberger. Their corrections and advice were then incorporated into the final version.

## Review Group's view of the Self-Assessment Report

The Self-Assessment Report was a very comprehensive, accessible and carefully organised document. It dealt with all aspects of the Mathematics Department, e.g., programmes and courses, teaching and learning, research and contributions to community. In particular, interesting tabular data and statistics were presented, e.g., breakdown of the number of students in the department from 2001 – 2006, B.Ed. and B.A. student grades from 2001 – 2005. An honest appraisal of department activities was presented in the SWOT analysis. Copies of the college strategic plan, the Mathematics Department strategic plan and student evaluations of courses were included. All members of the PRG commented on the ease with which the report helped them to gain insight into the nature of the Mathematics Department

## **4. Findings of the Review Group**

### Background and Context

#### *List of Thanks*

The Quality Promotion Co-ordinator (Dr. Daire Keogh), the Quality Promotion Administrator (Ms. Sharon King) and members of the Quality Promotion Committee  
Dean of Research, Mary Shine Thompson

The staff of the Mathematics Department

Students interviewed, i.e., Sample of Mathematics Students (1<sup>st</sup> year, 2<sup>nd</sup> year and 3<sup>rd</sup> year students of B.A. and B.Ed. programmes) and two students who did not opt for mathematics in 2<sup>nd</sup> year.

President of Students' Union, Shaun Conaughan

College President, Registrar, Secretary/Bursar

College catering

### *General positives*

There is a small number of staff in the department offering a programme of high quality to both BA and B.Ed students. The mathematics on offer is relevant to everyday life. All lecturers provide comprehensive notes on their web pages. The use of Maple software is an integral part of the course. Training on the use of this programme is given to students in first year. The enthusiasm on the part of the lecturers for the teaching of mathematics is very apparent. Of particular note is their warm relationship with students. Despite the heavy workload in teaching and related activities, members are engaged in research and in service to the community. The websites of the members are very well constructed and maintained and make all the course materials easily accessible for students.

### *Constraints*

The low uptake of mathematics in 2<sup>nd</sup> year was a focus of attention by the PRG.

The following table, taken from the Self-Assessment report, indicates the extent of this problem. It gives the year of admission for each cohort of students together with the number of students from that cohort completing each year of study.

Year of admission	Years completed		
	first	second	third
1999	33	14	14
2000	30	20	20
2001	44	18	18
2002	31	8	7
2003	32	16	16
2004	24	7	

Completion of studies – all students

It was acknowledged that this problem is not particular to SPD and that the negative attitude that exists in society towards mathematics compounds the problem. In the context of SPD, the general perception that mathematics is time-consuming combined with the students' heavy workload (particularly in the B.Ed programme), is a further constraint on engagement with mathematics.

The size of department (i.e. three full-time staff members) renders it difficult to expand the programme on offer to undergraduate students or for consideration to be given to postgraduate work. It also inhibits the provision of optional courses to students.

### Organisation and Management of the Department

The department is very small having just three members. Dr. John Cosgrave is the head of department and reports to the College Registrar and/or the College

President. Due to the size of the department, no formal meetings are held but mention is made of informal meetings and discussions. The Department has access to an administrative assistant whom it shares with a number of other departments.

### Planning and Evaluation

A department strategic plan for 2001- 2006 has informed the basis for much recent activity, e.g., development of department websites and preparation of mathematics documents. All courses are assessed by students. It was noted in the Self-Assessment report that the Department intends to address the need for routine planning of courses in the future.

### Programmes and Courses

In the Self Assessment report, data on the percentages of students taking mathematics as one of their subjects are presented. The percent of B.Ed students (in 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> year) ranges from 2.8% (in the academic year 2004 –2005) to 6.37% (in the academic year 2001 –2002). The percent of B.A students (in 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> year) ranges from 2.2% (in the academic year 2005 –2006) to 3.79% (in the academic year 2001 –2002). Although some of the reasons for the low uptake of the subject have been delineated above, others must also be considered. The minimum requirements for entry to the B.Ed programme are grade C3 in three higher level subjects in the Leaving Certificate, one of which must be honours Irish, a C in pass English (or a D in honours English) and a D in pass Mathematics. Although students typically present with more than the minimum entry requirements and with a higher grade in Mathematics than a grade D at pass level, there might be a perception that mathematics is not particularly relevant to primary teaching. Other deterrents include a restriction on subject combinations, e.g. students in the first year of the B.Ed. and B.A. programmes may not combine the study of mathematics with history, music and bioscience. A relatively high proportion of B.A. students are 'mature' students and these students might not be as attracted to mathematics as they might be to other subjects with which they might be familiar such as history or English.

First year B.Ed and B.A. students are offered courses in Calculus with Maple and Finite Mathematics and Linear Algebra. Second year B.Ed and B.A. students are offered courses in Analysis, Linear Algebra and Number Theory. Third year B.Ed and B.A. students take courses in Abstract Algebra, Number theory and Cryptography and Statistics. Joint courses on the Real Number System and Cantorian Set Theory and on Challenging Mathematical Puzzles and Problems are given jointly to Second and Third year B.A. students in alternate years.

Courses are assessed by means of continuous assessment (e.g., in-class written test, quizzes, Maple lab exam, mathematics reading assignment) for which 25% of marks are allocated and a three hour written examination which receives 75% of the total marks. A scaling mechanism is in place so that raw scores are converted to scores that conform to a common model that is in place for all departments in SPD (that is, where first class honours represents a grade between 70% and 75% etc.).

### Scholarship and Research

Members of the Mathematics Department are engaged in high levels of scholarship and research. In particular,

Dr. Cosgrave found the largest known composite Fermat number, using Gallot's computational programme and, later in the same year, broke the record again. He is presently collaborating with Professor Karl Dilcher (Dalhousie) on his (J. Cosgrave's) recent wide-ranging extension of Gauss' generalisation of Wilson's Theorem.

Dr. Breen has published and presented on Asymptotics and is currently collaborating with Dr. Joan Cleary (IoT, Tralee) and Dr. Ann O'Shea (NUIM) in a study of the mathematical literacy of third-level students and their attitudes to mathematics.

Dr. O'Reilly has collaborated with Professor Eugene O'Riordan (DCU) on the numerical solution of non-linear singularly perturbed equations and has been involved in several joint projects on intercultural and development education.

### Social and Community Services

All members of the Mathematics Department serve on college committees. They also make contributions to mathematics at primary and post-primary levels and to the wider mathematical community. In particular,

Dr. John Cosgrave has given a number of public lectures on Number Theory and Cryptography.

Dr. Maurice O'Reilly is very active in the area of intercultural and development education. He was president of the Irish Mathematical Society during a time when the state made significant decisions about mathematics

Dr. Sinead Breen has made important links with the mathematics education community

All members participated in Maths week (16<sup>th</sup> – 20<sup>th</sup> October 2006) which was co-ordinated by Dr. Maurice O'Reilly.

### Staffing, Accommodation and Resources

Students and head of department expressed satisfaction with resources.

Students are happy with access to Maple (outside hours)

The notice board is well-maintained and has attractive posters displaying mathematics problems and investigations.

## **5. Overall Analysis of Strengths, Weaknesses, Opportunities and Concerns**

### *Strengths*

High quality courses are provided for the B.A. and B.Ed students

A high degree of technical innovation is evident in the work of the department

The fundamental areas of algebra and analysis covered in the first two years of the B.A./B.Ed programmes are bases for the study of number theory and statistics in third year

The Mathematics Department is regarded by college management as an efficient department

### *Weaknesses*

The main weakness is the low attraction rate and low retention rate of students.

However, this is a systemic problem both nationally and internationally. Because of the serious implications of this for the development of technology, finding ways to make Mathematics more attractive to third-level students has been the subject of international debate for several years and no really good solution has been found thus far. In view of this, only limited success can be expected.

In their identification of weaknesses, the department pointed to the need for more formal meetings especially for programme review.

### *Opportunities :*

Links with mathematics education might be fostered, especially for post-graduate research.

There is an opportunity (a) for greater funding for research by the Science Foundation Ireland Science Foundation of Ireland and (b) for sponsorship by

Hamilton Mathematics Institute in Trinity College for public talks possibly leading to awareness of public of the relevance and usefulness of mathematics and (c) for collaboration with Mathematics Departments in other institutes through the Centre for the Advancement of Science Teaching and Learning (CASTeL)

### *Concerns*

Many of the students referred to the abstract nature of mathematics in first year and the large gap between the mathematics as experienced in secondary school and that in which they engage in the first year course.

Although they find the quizzes helpful and mathematics reading assignment interesting, students are concerned about the time that they spend on such assignments for relatively little gain.

Some students find Maple time-consuming

The number of first class honours among mathematics students is small after scaling and this is inconsistent with outcomes in mathematics in other institutions.

### 6. Recommendations for Improvement

- *P1: A recommendation that is important and requires urgent action.*
- *P2: A recommendation that is important, but can (or perhaps must) be addressed on a more extended timescale.*
- *P3: A recommendation which merits serious consideration but which is not considered to be critical to the quality of the ongoing activities in the Department.*

*Additionally, the PRG has attempted to indicate the level(s) of the College where action is required:*

- *D: Department*
- *F: Faculty*
- *U: College Executive/Senior Management*

*Where considered appropriate, action at multiple levels is recommended: this should be considered as inclusive, indicating a need for co-ordinated, complementary, actions at all the indicated levels (rather than, e.g., at “any one level”).*

*For instance: P1-SF would indicate a recommendation that is important and requires urgent agent at Department and Faculty Level*

### Review of Courses

(P1: D) A review of courses is indicated in the department’s own strategic plan and the PRG would strongly encourage it. Two matters need particular attention:

(i) The question of whether there are aspects of the programme that discourage students from continuing should be examined. Could some elements be moved or removed without detriment to the programme? Some of the course content in first year is perceived by the students to be too abstract. School mathematics does not require the precision and formality of university mathematics and even very good students can be slow in learning to adjust to this. This can cause a loss of confidence, and lessen their chances of selecting Mathematics after first year. Interestingly, the PRG noted that the fact that the Maple language requires precision in its syntax and grammar, causes negativity towards it in some students also. However, the students are well disposed to graph theory even though this is a new subject for them, i.e., they appear to be well disposed to concrete examples. It also

provides a good subject for developing rigour in proofs while, at the same time, the diagrams are a great aid to understanding. The PRG strongly recommends that in the review of courses, more of this discrete Mathematics be put into the first year programme, while rigorous foundational treatment of numbers be postponed until later years.

(ii) The course that is offered is different to that usually offered in undergraduate courses in that it is lacking in multi-variate analysis, differential equations and complex analysis. The argument for this is that these students are destined to be (or aspire to be, in the case of many BA students,) primary school teachers. These topics have been replaced by a rigorous treatment of foundations of analysis and by a concentration on number theory with particular emphasis on application in cryptography. The department might look more closely at linking number theory with abstract algebra. It might also consider whether courses on multi-variate analysis might be offered. While students who become primary school teachers are unlikely to use any of the finer points of their final year Mathematics courses in their teaching and thus, choosing to cover one interesting mathematical topic rather than another is primarily a matter of taste, the exclusion of multi-variate calculus is still surprising. Having a course in it, at least as far as partial derivatives and knowing optimization techniques, would be assumed to be part of a Mathematics degree programme by any potential employer of any of the graduates who for any reason, want to pursue a different path for which mathematical achievement is required. In particular, a graduate seeking a position in the currently fashionable financial services area would be at a disadvantage. We recommend that in reviewing the course, the decision to exclude this topic be looked at again.

(P2: D) A colourful, comprehensive student programme handbook might help to attract students to the subject.

(P3: D) The possibility of offering optional courses in mathematics to students should be investigated. However, this would require additional resources.

(P2: U) The possible limiting effect of present choices of subject combinations should be explored.

### Assessment

(P2: D) Greater weighting should be given to continuous assessment rather than to end of year examination.

(P2: U) As the proportion of first class honours among mathematics students in SPD is inconsistent with outcomes in other institutions, the effect of the scaling mechanism on students' scores in mathematics needs to be examined. To this end, the possibility of altering the ceiling in other subjects might be considered.

### Research Opportunities

(P3: F) It is recognized that that it would be impossible to offer graduate study of mathematics. However the present links with mathematics education might be harnessed to allow for post-graduate research.

(P3: D) Through SFI initiatives and collaboration with groups such as CASTeL, there is the possibility of enhancing the perception of mathematics in society and thereby in the eyes of the students.