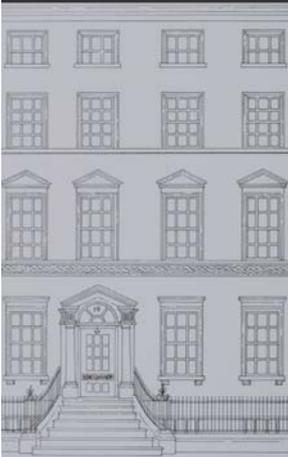


ROYAL IRISH ACADEMY



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RESPONSE BY THE ROYAL IRISH ACADEMY COMMITTEES OF MATHEMATICAL SCIENCES, ENGINEERING SCIENCES AND CHEMICAL & PHYSICAL SCIENCES TO THE PROPOSAL TO OFFER 'BONUS POINTS FOR MATHS'

The Royal Irish Academy is an all-Ireland, independent, academic body that promotes excellence in scholarship and research in the sciences and the humanities. It is the principal learned society in Ireland and has 385 members elected in recognition of their achievements in scholarship and research. The Academy provides independent expert advice to government on research and higher education issues and seeks to inform public policy development on issues relevant to the sciences and the humanities.

**‘BONUS POINTS FOR LEAVING
CERTIFICATE HIGHER-LEVEL
MATHEMATICS’:
A RESPONSE BY THE ROYAL IRISH
ACADEMY’S COMMITTEES FOR
MATHEMATICAL SCIENCES, ENGINEERING
SCIENCES, CHEMICAL AND PHYSICAL
SCIENCES**

SUMMARY OF RESPONSE

It is the view of the Royal Irish Academy’s Committees for Mathematical Sciences, Engineering Sciences and Chemical and Physical Sciences that the reintroduction by some universities of bonus points for students of higher-level Leaving Certificate Mathematics is unlikely to result in a significant increase in the numbers of students applying for and taking-up third-level courses in science, engineering and technology disciplines. The Committees are of the view that should the decision be made by universities to award bonus CAO points for higher-level Leaving Certificate mathematics then it must be possible for students to apply these bonus points in support of their application to all third-level courses not merely science related courses.

INTRODUCTION

1. The Royal Irish Academy’s Committees for (i) Mathematical Sciences, (ii) Engineering Sciences, and (iii) Chemical and Physical Sciences¹ wish to take this opportunity to comment on the recent (January 2008) request by the Minister for Education and Science that universities consider reintroducing bonus CAO points in higher-level Leaving Certificate (LC) Mathematics for students taking third-level science, engineering or technology (SET) courses. The measure – as it is currently presented - is intended to increase the level of demand for, and numbers of students pursuing SET courses at third-level.

The Committees response considers the arguments for and against this proposal and outlines a number of key issues impacting upon the demand for and take-up of higher-level Leaving Certificate mathematics at second-level and SET courses at third-level.

2. The Committees welcome the government's continuing recognition of the strategic importance of mathematics, science, engineering and technology to Ireland. As noted in a range of recent government reportsⁱⁱ, a sustained supply of SET professionals and a mathematically literate population are critical to the development of a world-class research system and to underpin Ireland's economic and industrial development in sectors as diverse as the physical and technological sciences, life sciences and financial sectors.

3. The Committees recognise that awarding bonus points for Mathematics may not have the desired effect, if such a measure is applied in isolation. The award of bonus points is simply one strand underpinning a structure of enormous complexity, and alone is incapable of delivering any significant improvement in the short-term demand for and take-up of SET courses at third-level. A broader canvas of more fundamental issues needs to be addressed in a logical and coherent fashion if Ireland is to achieve its wider national goal of increasing society's participation in the sciences and supporting greater mathematical and scientific literacy. The key to guaranteeing a steady stream of graduates in SET courses is to maintain a steady supply pipeline of mathematically prepared students at second-level. Currently such delivery is severely constrained by fundamental issues relating to teaching and learning at second-level and also by perceptions among second-level students concerning the difficulties of studying Mathematics. These issues will be addressed in greater detail below.

ARGUMENTS FOR AND AGAINST

4. Notwithstanding such difficulties, the Committees are of the view that arguments for/against the current proposals may be summarised as follows:

Arguments for

- (i) It may encourage more students to pursue higher-level LC Mathematics;
- (ii) An increase in student numbers completing higher-level LC Mathematics increases the potential pool of students capable of pursuing third-level SET courses;
- (iii) The proposal to award bonus points underlines the importance of Mathematics in all the science related subjects;
- (iv) The proposal to award bonus points is a fairer reflection of the workload involved in taking higher-level LC Mathematics.

Arguments against

- (i) It may not produce the desired effect. The number of points required for many SET courses is currently quite low and so the issue is not necessarily that of high entry points acting as a barrier to entry. Students who intend to pursue a SET course may see no need to do higher-level LC Mathematics when they can acquire the required number of points in other, perhaps less challenging, ways;ⁱⁱⁱ
- (ii) There is no guarantee that a student who takes higher-level LC Mathematics will then pursue a third-level SET course (e.g. a high percentage of students pursuing a primary degree in Medicine have taken higher-level LC Mathematics);
- (iii) The award of bonus points may reinforce negative perceptions among students as to the difficulty of higher-level LC Mathematics and lead some to think that it is a subject only for an elite group of the very brightest pupils;
- (iv) The award of bonus points does not address the pipeline issues affecting student take-up at second-level of higher-level Mathematics;
- (v) The proposal to award bonus points disadvantages second-level students in schools where higher-level Mathematics is not a subject option;^{iv}
- (vi) The proposal to award bonus points raises the likelihood that other disciplines will seek bonus points for their subject citing similar reasons e.g. to reward 'effort' involved in study of subject, encourage greater participation in specific third-level courses, etc.

ISSUES AT SECOND-LEVEL

5. There is general agreement as to the need for urgent measures **to encourage greater uptake by students of higher-level Junior Certificate (JC) and Leaving Certificate (LC) Mathematics**. Increasing the numbers at JC level would also increase the pool of students who might consider taking higher-level LC Mathematics and increase the pool of potential entrants to third-level SET courses. (For example, a minimum of a grade C in higher level LC mathematics is a prerequisite for entry to accredited third-level Engineering courses).

Students' results at the JC level may also restrict their progression to higher-level LC mathematics. At present, 42 per cent and 18 per cent of the total second-level intake of students pursue higher-level JC and LC mathematics respectively. Of the 42% who opt for higher-level Mathematics at JC level, approximately 76% obtain a grade C or higher; if we assume that those with lower grades in JC Mathematics find it difficult to proceed to higher-level LC Mathematics at and in fact drop the subject, then this suggests that the maximum possible percentage of

the first year intake to do higher-level LC Mathematics would be 32%, that is, 76% of 42%. Initiatives to increase the numbers at LC level should thus engage with initiatives to increase the numbers taking higher-level JC Mathematics.

So why do so relatively few pupils do higher-level Mathematics in Junior Cycle? This is a long-standing and perhaps intractable problem, but many are convinced that a major part of the problem has to do with the very small number of persons teaching Mathematics who are actually qualified in the subject. The **quality of the teaching and learning experience** has a highly significant effect on student performance and subject choice. Teacher qualifications are key to the overall quality of the teaching experience. The availability of teachers whose primary degree qualification is in Mathematics significantly determines the overall quality of the teaching and learning experience for students of LC Mathematics. Although there is little hard data on this issue, it is generally accepted that few teachers of second-level Mathematics currently hold a primary degree in Mathematics, a consequence perhaps of the low numbers of Mathematics graduates choosing to pursue a career in second-level teaching. Current 'best guess' estimates reckon that as few as 20 per cent of teachers of second-level Mathematics studied it as a major subject beyond the first year of their primary degree. It would however, be useful to have more concrete information: the current survey of teachers' qualifications by The Teaching Council is to be welcomed as a first step in providing robust evidence on this issue. Additional information on the factors influencing the career choices of Mathematics graduates would also be informative. The Department of Education and Science should also consider measures to increase the number of Mathematics graduates entering the teaching profession and to increase the opportunities for second-level Mathematics teachers to participate in continuing professional development. (In early 2008, the UK Minister for Schools, Department for Children, Schools and Families, announced a £140m funding package for Science Technology Engineering and Mathematics in support of national policy objectives and initiatives aimed at increasing the number of science and maths teachers, improving results at GCSE and increasing the number of young people studying these subjects post-16 years of age).^v

A number of studies (e.g. the NCCA *Review of Mathematics in Post-Primary Education*, 2005) highlight the importance of **students' perceptions and attitudes** in determining take-up of higher-level Mathematics. Initiatives to encourage take-up must be carefully designed to ensure that they do not inadvertently confirm some students' fears as to the difficulty of the subject. Further study may shed useful light on the extent to which the flight of students from higher-level Mathematics at second-level is a reflection of negative student

attitudes regarding the difficulty and heavy workload involved in studying and achieving high grades in the subject at LC level.

The Minister for Education and Science refers frequently to the National Council for Curriculum Assessment's (NCCA) initiative *Project Maths*, which involves significant syllabus reform, the introduction of new syllabuses for JC and LC Mathematics, extensive teacher professional development and the provision of classroom materials. This is a welcome development, and it is to be hoped that it will lead to an increase in the number of students pursuing higher-level LC Mathematics and an improvement in the mathematical skills and literacy of the general student body.

ISSUES AT THIRD-LEVEL

6. It is important to acknowledge the concerns of those within the third-level system as to the **lack of fluency in basic mathematical skills** shown by many entrants to SET courses. Widening participation in higher education – from just 10% of school leavers in the 1960s to nearly 50% today – also brings with it a more diverse student body with a wider diversity of abilities. It is generally agreed that the standards of mathematical fluency displayed by new entrants to the third-level SET courses is more varied today than previously.

It is also widely agreed that career opportunities for scientists influence student take-up of SET courses at third-level. Further information on students' perceptions of the opportunities for career progression and reward for scientists in Ireland would also be useful to determine whether or not such issues negatively impact on students decision-making in choosing whether or not to pursue a third-level SET course.

SUMMARY OF COMMITTEES RESPONSE

7. Given the realities of just how complex the issue is, the Committees are of the view that **the reintroduction by some universities of bonus points for higher-level mathematics is unlikely to result in a significant increase in the numbers pursuing science related courses at third-level** or to address the more fundamental issues affecting take-up of such courses. The number of CAO points required for many SET courses is currently quite low and so the issue is not necessarily that of high entry points acting as a barrier to entry to many science courses.

The Committees are of the view that **should the decision be made to award bonus CAO points for higher-level mathematics then it must be possible for students to use the bonus points regardless of their third-level course**

preference i.e. that bonus points support students applications to any third-level course not merely SET courses. The Committees believe this is vital to ensure that:

- Mathematics is not perceived simply as a service subject to be used in other disciplines and that ‘mathematical fluency’ is recognised as being particularly useful in a wide range of professions (even when not explicitly required);
- Initiatives to promote greater participation in mathematics and science related courses form part of the broader continuum of initiatives to improve the mathematical literacy of the general population;
- Study of the sciences is not prioritised to the detriment of the humanities at third level.

Finally, the Committees are not agreed on the principle of awarding bonus points for higher-level mathematics. Some members believe that it may serve to encourage a greater uptake of the subject at second level and that it would certainly reward and reflect the greater level of student effort and workload involved in studying the subject. (A 2005 report by the Academy’s Committee for Chemical and Physical Sciences *School Science Infrastructure: can Ireland deliver?* explores these issues in greater detail). Others are persuaded by the counter arguments given above and in particular, would echo the concerns^{vi} that the awarding of bonus points may have a distorting effect on second-level curriculum and subject choice. All are agreed, however that the award of bonus CAO points by itself would be insufficient to solve the more fundamental problems that beset the teaching and learning of Mathematics as outlined in this paper.

ABOUT THIS RESPONSE

8. This paper has been compiled by a working group composed of the Academy’s Science Secretary, the Chairs of the Academy Committees for Mathematical Sciences, Engineering Sciences and Chemical and Physical Sciences and the Academy’s Senior Research and Policy Officer, as follows:

- Professor David Fegan, MRIA, RIA Science Secretary
- Dr. Richard Watson, Chair, Academy Committee for Mathematical Sciences
- Professor John Fitzpatrick, MRIA, Chair, Academy Committee for Engineering Sciences
- Professor John Kelly, MRIA, Chair, Academy Committee for Chemical and Physical Sciences
- Ms. Sinead Riordan, RIA Senior Research and Policy Officer

R O Y A L I R I S H A C A D E M Y

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END NOTES

ⁱ The Academy maintains a network of academic committees ('Academy Committees') representative of the broad fields of study within the sciences and the humanities. These Committees support and inform the organisation and development of their respective disciplines. Further information on the Academy Committees and policy work is available at: www.ria.ie

ⁱⁱ See report of the Expert Group on Future Skills Needs (2007), *Future Skills and Research Needs of the International Financial Services Industry*, Dublin: Forfás.

ⁱⁱⁱ Although this is not the case for the majority of third-level engineering courses where the majority of cut-off levels are in the 400s and where entrants are required to have obtained a minimum of a Grade C in higher-level Leaving Certificate mathematics or its equivalent.

^{iv} In correspondence with the Department of Education and Science, the Irish Mathematical Society was informed that there were 58 schools with apparently no pupils doing higher-level LC mathematics in the 2005/06 school year. Note that there are difficulties in interpreting this figure, since some of the schools listed are in fact Colleges of Further Education ^{iv}

^v For more information on this initiative see the Department for Children, Schools and Families, http://www.dfes.gov.uk/pns/DisplayPN.cgi?pn_id=2008_0017.

^{vi} As per the Report of the Points Commission (1999).