

## IUA response to proposal to award bonus points for higher level Leaving Certificate mathematics

### 1. Introduction

A number of statements have been made in recent months regarding the desirability or otherwise of awarding bonus points for higher level Leaving Certificate mathematics (LC honours maths). It is widely agreed that it is desirable to increase the numbers of students wishing to study Science, Engineering and Technology (SET) subjects in higher education. Mathematics is of fundamental importance to careers in engineering, experimental and numerative disciplines, and is of strategic importance to Ireland's transformation to an innovation driven society. Passing the LC honours maths examination is a specific entry requirement for most higher education courses in SET areas. There is therefore a need to ensure high numbers of LC students take this subject.

However, many students who take LC maths do not go on to study in SET areas, and are attracted by courses in a broad range of other academic fields. Increasing the numbers of LC honours maths students, although essential in terms of enlarging the pool of potential SET applicants, will not, by itself, lead to a meaningful increase in the numbers of SET students. This requires a broader set of measures and has been the object of sustained efforts by universities, individually and collectively through the Irish Universities Promoting Science network (<http://www.universityscience.ie/>), other higher education institutions, and a range of bodies including government departments, the secondary school system, the HEA, the RIA, interdisciplinary working groups, etc. By comparison with other leading OECD countries, Ireland has, through such efforts, managed to maintain higher proportions of students choosing to study SET, although this relative advantage represents cold comfort when the overall levels of SET take-up remain low.

Some stakeholders in this field have expressed the opinion that awarding bonus points for LC honours maths will increase the level of demand and interest in SET among second level students. This topic has been closely examined within the university sector over the last year, including at the levels of IUA Council (University Presidents), IUA Registrars, Deans of Science, Admissions Officers, and within each individual university.

The overall outcome of those discussions is a widely held view that, on the basis of CAO data, the recommendations of the Points Commission and the reports of the National Council for Curriculum and Assessment (NCCA), the introduction by the universities of bonus points for LC honours maths is unlikely to achieve the national objective of greater participation in SET or dramatically increase uptake of LC honours maths.

This conclusion mirrors the joint view of the mathematical, engineering, chemical and physical science committees of the RIA. Such a measure would not address any of the fundamental causes of the range of complex challenges and problems in this area, but would simply serve to mask the real issues. There are a number of other, longer-term solutions and potentially more effective responses to the need to increase the numbers of students taking LC honours maths and participating in higher education SET programmes. These issues are further discussed below.

## 2. Current CAO data regarding honours mathematics, from a university perspective

### 2.1 CAO applications and admissions, 2007

In 2007, 58,414 CAO applicants applied for a Level 8 Degree programme. Only 8225 (14%) of these applicants sat and passed the honours maths LC examination. The numbers of CAO applicants with honours maths applying for and accepting places in the university sector is considerably higher than the national average, ranging from 15-25%, as table 1 below illustrates:

Table1: 2007 CAO data for total applicants and acceptances, University applicants and acceptances and honours mathematics for Irish school leavers

	Number of Level 8 Degree applicants	Number of Level 8 applicants with honours mathematics in Leaving Cert (LC)	% of Level 8 applicants with LC honours mathematics	Total number of Level 8 acceptances	Number of Level 8 acceptances from Irish School Leaver (SL) cohort	Number of Level 8 SL acceptances with honours mathematics	% of Level 8 SL acceptances with honours mathematics
CAO Degree total	58,414	8,225	14	27,755	22,503	6,511	29
DCU	14,319	2,641	18	1,760	1,432	453	32
NUI Galway	14,167	2,899	20	2,848	2,326	665	29
NUI Maynooth	10,012	1,508	15	1,751	1,340	269	20
TCD	16,207	4,059	25	2,425	1,826	1,011	55
UCC	15,021	3,106	21	3,603	3,003	1,064	35
UCD	22,322	4,907	22	4,127	3,402	1,268	37
UL	13,769	2,652	19	2,178	2,001	705	35
University sector				18,692	15,330	5,435	35
Science/ Applied Science/ Engineering/ Technology				5,992	5,244	2,539	48
Medicine and Health				3,366	2,287	751	33
Other areas				18,397	14,972	3221	22

This data for 2007 CAO applications and acceptances indicate that:

#### *2007 applications:*

- 14% of all 2007 applicants to the CAO for Level 8 Honours degree programmes had honours mathematics
- This percentage was higher across all seven of the Irish Universities, ranging from 15% to 25%.
- The number and percentage of applicants presenting with honours mathematics were not higher in the one University (UL) where bonus points are (and have traditionally been) awarded for honours mathematics.

#### *2007 acceptances:*

- 29% of students accepting a place in an Honours Bachelor degree (Level 8) programme in 2007 had LC honours mathematics.

- When the University sector is considered separately, the percentage of acceptances with LC honours mathematics rose to 35%, i.e. one in three students.
- In the one University where bonus points are currently awarded for LC honours maths, the percentage of acceptances with honours mathematics was not higher than the University average (35%).
- 83% of all LC students with honours maths who accepted a place in a Level 8 programme chose to study in the University sector, i.e. more than 4 out of every five such students.
- Of all LC students with honours maths accepting a Level 8 place, 39% accepted a programme in Science, Applied Science, Engineering and Technology, i.e. over 60% pursued a Level 8 programme in a subject area other than SET.
- 48% of those who accepted places in Level 8 programmes in Science, Applied Science, Engineering and Technology had LC honours maths, i.e. over 50% of those accepting places in Level 8 SET programmes did not have LC honours maths.
- Almost all of the students admitted to university programmes in Science, Applied Science or Engineering will also have presented a laboratory science subject, as this is normally a minimum entry requirement for these programmes.

This preliminary analysis would indicate that over 70% of students accepting a place in a Level 8 programme in 2007 did not have LC honours maths. It also indicates that over 60% of students with LC honours maths chose a field of study other than the Science, Applied Science, Engineering and Technology areas. In some programmes, such as medicine, 75% of the 2007 Irish school leaver acceptances (253/334) had honours mathematics. There is therefore no guarantee that a student who takes honours mathematics will enter into the physical sciences or engineering, even where additional bonus points for mathematics are awarded.

## **2.2 Bonus points for SET applicants only**

It has been suggested that bonus points should only be given to applicants to SET programmes. This proposal has been strongly rejected in the paper prepared by the Royal Irish Academy committees of mathematical sciences, engineering sciences and chemical and physical sciences. The RIA believes that it is vital to ensure that “maths 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)”. The RIA also states the importance of “initiatives to promote greater participation in mathematics and science-related courses [which] form part of the broader continuum of initiatives to improve the mathematical literacy of the general population”.

Furthermore, the RIA believes that the study of the sciences should not be prioritised to the detriment of the humanities at third level. It could also be added that awarding bonus points only for applicants to SET programmes would artificially increase the cut-off points levels for applicants in these areas, without necessarily increasing the demand. For example, students who currently meet the university matriculation requirements for Engineering (which includes an honours mathematics requirement) are almost guaranteed a place in an Engineering programme, given current levels of applications and quotas.

## **2.3 Numbers of students sitting LC honours maths**

The number of LC students sitting honours maths is strongly conditioned by the number of schools which actually provide this option. Further data from the CAO shows that, of the 786 second level schools recorded for the 2007 Leaving Certificate, candidates presenting honours mathematics came from a total of 640 different schools. Therefore, a minimum of 146 schools had no candidates

presenting honours mathematics that year. It is safe to assume that a minimum of 146 schools do not offer LC honours mathematics, i.e. approximately one in five.

This number is considerably greater than the number of such schools (58) quoted by the RIA in its paper, which used data supplied by the Department of Education and Science. The fact that such a large proportion of schools do not appear to teach honours maths immediately and dramatically reduces the options of important numbers of potential SET students. It should be noted that awarding bonus points for LC honours maths would further disadvantage all students from such schools where this subject is not even an option, placing them at a relative disadvantage in terms of points to students from other schools where LC honours maths (and therefore bonus points) were available.

## **2.4 Numbers of students sitting Junior Certificate honours maths**

Increasing the numbers of LC honours maths students will also require increasing the numbers of students who sit this subject at Junior Certificate (JC). The RIA has noted that, at present, 42% of the total second-level intake of secondary school students pursue higher level JC maths. Assuming that those who do not obtain at least a C in this subject at JC (24%) find it difficult to proceed to LC honours maths, the RIA then calculates that the intake to the first year of the LC honours maths curriculum would, in the best of cases, be 32%, i.e. 76% of 42%.

By the time of application to CAO (one and a half senior cycle school years later), this percentage has decreased to the order of 14% (percentage for 2007 applicants with LC honours maths, quoted above, for applicants to Level 8 Honours degree programmes). During this period there has been additional attrition of more than 50% in the numbers of LC honours maths students. It thus becomes clear that there are major challenges which need to be addressed in the perception and teaching of mathematics in the secondary school system, which will not be addressed simply by offering bonus points for LC honours maths.

## **3. Report of the Points Commission (1999)**

The issue of bonus points for LC honours maths was considered by the Points Commission (1999) and rejected. In the opinion of the universities, the arguments given by the Points Commission in its report remain valid. Section 5.1.1 of its report concluded:

“Bonus points would possibly have a distorting effect on second-level curriculum and subject choice. In particular, it is likely that it would:

- lead to a narrowing of the range of subjects taken by students, with negative consequences for second-level students and the second-level system.
- increase pressures on students to focus too early on course and career choice. This could create difficulties for students who either changed their minds about their career and course preferences or who failed to be accepted for their top course options.
- place at a disadvantage students attending schools where certain subject options are not available.

Furthermore, the Commission considers that, as far as possible, in determining entry to third-level, institutions should not treat one element of the Leaving Certificate programme as more important than other elements. On balance therefore, the

Commission recommends that bonus points should not be given for specific subjects”.

#### 4. Curriculum Review

Recent national curriculum review reports, including *International Trends in Post-Primary Mathematics Education* (2005), *Review of Mathematics in Post-Primary Education* (2005), as well as the government’s *Strategy for Science, Technology and Innovation 2006-2013*, all highlight the importance of students’ “attitude to mathematics” as a factor of their success in this subject. As noted by the RIA, it is possible that awarding bonus points to LC honours maths could potentially “reinforce negative perceptions among students as to the difficulty of higher-level LC mathematics, leading some to think that it is a subject only for an elite group of the very brightest pupils”. The counter-argument that the “award of bonus points is in fact a fairer reflection of the work-load involved in taking LC honours maths” could serve to reinforce this negative perception. The National Council for Curriculum and Assessment’s (NCCA) *Review of Mathematics in Post-Primary Education 2005* noted that “students see mathematics as effortful – ‘hard work’ and ‘natural ability’ are required to do well in the subject. The issue of ‘mathophobia’, or fear of mathematics, is important.”

In this context, the addition of bonus points could potentially be counter-productive for those students already in awe of the subject, confirming their perception that honours mathematics is more difficult and will take too much time from their other LC subjects. The risk for such a student of not performing well in a subject bearing bonus points is likewise all the greater, since the number of points at risk is larger. Rather than serve as an attraction to LC honours maths for students who perceive maths as more difficult, these bonus points may well in fact serve as a further deterrent, with the consequent loss of a place at third level where a pass in mathematics is an essential requirement.

The NCCA expressed the view that a very effective way to attract greater numbers of students into honours maths and SET fields is through a more attractive curriculum, taught by highly motivated, well resourced and qualified teachers with clear learning outcomes for students. This view is reflected in the RIA paper, which notes that “the quality of the teaching and learning experience has a highly significant effect on student performance and subject choice”, and that “teacher qualifications are key to the overall quality of the teaching experience”. It also notes that, despite little hard data, “it is generally accepted that few teachers of second level mathematics currently hold a primary degree in mathematics”, and that “current ‘best guess’ estimates reckon that as few as 20% of teachers of second-level mathematics studied it as a major subject beyond the first year of their primary degree”.

These data show that action is needed to increase the numbers of mathematics graduates teaching maths in the school system, as one element of improving the qualifications of teachers in this area. A number of possible paths could be explored to make this career option more appealing to maths graduates. Professional development for existing teachers in the system is also vital. In terms of the student learning experience, the new Project Maths initiative developed by the NCCA and recently launched by the Minister for Education and Science can also make a most positive impact. Although currently being piloted in a limited number of schools, it is hoped that this initiative will indeed lead to a new perception of maths among the broad student body, improved mathematical literacy among all school leavers and – in time - increased uptake of SET options in higher

education. The universities are contributing to these important developments through their nominated representative to the NCCA's Mathematics Board of Studies.

## **5. Promoting science, engineering and technology**

Each Irish university is very active in the field of science promotion and outreach activity. Examples include SET courses throughout the year as part of school liaison programmes, open days, visits to schools, transition year projects, workshops and experiences, science festivals and summer workshops, engineering weeks, open lectures, etc. Many universities have a science promotion office.

Collectively, all universities collaborate to promote the attractiveness of science through the Irish Universities Promoting Science network (<http://www.universityscience.ie/>). IUPS concentrates collective efforts on two major communication activities. The first is the BT Young Scientist Festival held in January each year, during which the universities collaborate to provide appealing and informative demonstrations for more than 10,000 students. The focus is on engagement and discovery to promote science. This activity is prepared in the run up to the Young Scientist Festival through direct links organised by each university between teachers, pupils, and academics. Given that many schools do not however participate in this Festival, these activities should be considered as promotional rather than a systemic intervention.

The second sectoral IUPS activity is the "Science Speak" science communication competition. The finals of this are held in the RDS each year and achieve national exposure in press and broadcast media. This competition involves young scientists explaining their work to an open audience. It is supported by a number of regional heats and finals in the seven universities. This is likewise a demonstration activity.

Dublin City University has a designated research centre CASTeL – the Centre for the Advancement of Science Teaching & Learning – with a multidisciplinary research team involving scientists, mathematicians and educationalists from DCU and St Patrick's College, Drumcondra. The University of Limerick has likewise been awarded funding under the Strategic Innovation Fund for a new National Centre for Excellence in Mathematics and Science Teaching and Learning, which will support teaching and learning in these areas. The research and training being undertaken by the university sector is designed to contribute to improved teaching and learning in these areas.

The Universities are also of the view that a sustained programme of investment in third level science facilities and infrastructure is required to bring such facilities up to world class standards and to encourage prospective students to view SET as an attractive option in their choice of university course.

The Senate of the National University of Ireland (NUI) agreed in January 2008 to a major review of matriculation requirements. The required subject areas, including science and mathematics, will be considered as part of that process. The universities may therefore also be in a position to give greater support to science through matriculation requirements.

## **6. Summary**

In summary, the universities agree that the introduction of bonus points for LC honours mathematics is unlikely to achieve the national objective of greater participation in SET. Such a measure would not address any of the fundamental causes of the complex challenges and problems

facing the teaching and learning of maths in our schools, but would simply serve to mask the real issues. There are a number of other, longer-term solutions and potentially more effective responses to the need to increase the numbers of students taking JC and LC honours maths and participating in higher education SET programmes.

Awarding bonus points for applicants to SET programmes would artificially increase the cut-off points levels for applicants in these areas, without necessarily increasing the demand. Students who currently meet the university matriculation requirements for Engineering are almost guaranteed a place in an Engineering programme, given current levels of applications and quotas.

In cooperation with a broad range of partners, the universities will continue, individually and collectively, to promote awareness and interest of all learners, particularly those at second level, in maths and science related areas, and to contribute to improved teaching and learning in these areas. The overall objectives of this activity are to attract greater numbers of students into honours maths and SET fields, and to contribute to the enhanced mathematical and scientific literacy of the population as a whole.

### **References:**

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