# Incentivising the study of advanced mathematics: A comparative analysis of Ireland and Queensland

**Niamh O'Meara**
*University of Limerick, Ireland*
**Michael Jennings**
*The University of Queensland, Australia*
**Mark Prendergast**
*University College Cork, Ireland*
**Páraic Treacy**
*Mary Immaculate College, Ireland*

There are substantial and ongoing concerns in the international secondary and tertiary education sectors about the number of students choosing advanced or higher-level mathematics at upper secondary level. Declining enrolments in the last two years of secondary school in higher-level mathematics is seen as a major concern for the future of STEM education. Due to these concerns incentives have been introduced internationally to arrest this decline. In Ireland, the bonus points initiative came into effect in 2012, whereby students were awarded 25 additional points if they obtain a score of 40% or more in higher-level mathematics in a terminal nation-wide examination. These additional 25 points are then added to their total points score from all subjects and this score dictates whether they gain entry to the tertiary course of their choice. However, research conducted into the effectiveness of this policy has identified numerous issues including students not suitable for higher-level mathematics pursuing it and as a result higher-level teachers are facing a much wider range of abilities in their mathematics lessons. This led the authors to look internationally to see if lessons could be taken from other jurisdictions that had incentivised the study of higher-level mathematics. In Queensland, Australia, higher-level mathematics is also incentivised through the use of bonus points. In this case, a student who passes higher-level mathematics in Year 12 will receive two bonus points towards their university entrance score. While these policies appear to be very similar in nature, the primary difference across the two jurisdictions is the weighting of the bonus points. In this paper we will look at the impact that these incentives have on students' decisions to pursue higher-level mathematics in both jurisdictions, and determine if each jurisdiction can learn lessons from the variations in the way bonus points policies are implemented.

## Introduction

The challenge of engaging and retaining upper secondary school students in the study of the most advanced forms of mathematics, henceforth referred to as higher-level (HL) mathematics, is a complex one (O'Meara et al., 2020). However, it is a challenge that has begun to receive global attention of late. Policymakers internationally have acknowledged the need to ensure a high proportion of students study HL mathematics due to the associated benefits (Hine et al., 2021; Noyes et al. 2023). The benefits described in the research range from the development of lifelong skills, to improved uptake and performance in other STEM-related disciplines, as well as greater access to tertiary level programs and subsequent job prospects. Firstly, we consider the link between the study of

HL mathematics and the development of 21st century knowledge and skills. The study of HL mathematics can facilitate the development of reasoning, problem-solving and decision-making skills (Noyes et al., 2023; Sheldrake et al., 2015; Kennedy et al., 2014). Chinnappan et al. (2008) surmised these findings when he asserted that HL mathematics facilitates the development of skills that underpin a scientifically literate workforce. He, along with other researchers, believed that students who study HL mathematics are well prepared to excel in an array of different scientific disciplines, including physical sciences, computer sciences, engineering, and medicine (Hine, 2023).

As such, increasing the number of students studying HL mathematics can help Governments and policymakers realise their goals of producing a scientifically literate workforce equipped with the skills needed to meaningfully engage in our highly digitised and scientific world. Furthermore, Noyes et al. (2023) reported a correlation between mathematical competency and economic productivity. They outlined how the procedural and problem-solving skills acquired in the mathematics classroom are required to facilitate economic growth worldwide and as such they believed that the study of HL mathematics can strengthen the drive to increase human capital (Noyes et al., 2023).

In addition to facilitating the development of this broad range of knowledge and skills and helping to prepare students for study in other STEM disciplines, research has also pointed to a correlation between the study of HL mathematics and entry to tertiary study. Mujtaba et al. (2014) found that students who studied HL mathematics were more likely to secure a place in tertiary programs. In Ireland, many science, engineering, and technology degree programs have minimum requirements for attainment in HL mathematics. As a result, students who do not opt to study HL mathematics at upper secondary school in Ireland will limit the options available to them at tertiary level (O'Meara et al., 2023). Additionally, research conducted by Hine et al. (2015) showed that students who had high levels of mathematical knowledge on graduation from secondary school were more likely to succeed at tertiary level, regardless of the program of study undertaken. Finally, and leading on from the correlation between the study of HL mathematics and access/performance in tertiary degree programs, Pickering et al. (2025) found a relationship to exist between the study of HL mathematics and future earnings. They determined that students who studied HL mathematics had an 11% earning premium compared to students who dropped mathematics at the end of lower secondary school. This finding also emerged in the work of Adkins and Noyes (2016: 112) when they found a *"…strong and positive association*" between the study of HL mathematics and *"…future earnings at age 34"*.

These findings highlight the range of benefits associated with studying HL mathematics at upper secondary level. Despite this, there are substantial and ongoing concerns in the secondary and tertiary education sectors about the number of students choosing HL mathematics in upper secondary school. Declining enrolments in HL mathematics in the final years of secondary school is seen as a major concern for the future of STEM education.

## The declining uptake of HL mathematics

Many jurisdictions worldwide continue to report issues with the uptake of HL mathematics, particularly at upper secondary level. For example, in the UK, schooling is compulsory until the end of Grade 11 (16 years) at which time students receive General Certificate of Secondary Education (GCSE) qualifications. Students who remain at school for Grades 12 and 13 may receive the General Certificate of Education (GCE) A-Levels, which is the highest secondary school leaving qualification in England, Wales, and Northern Ireland. In Scotland, GCE A-Levels are offered by some schools instead of the Scottish Advanced Higher qualification. UK students usually study three or four subjects for A-Levels and mathematics is not compulsory. Enrolments in HL mathematics in the UK suffered a decline over 30 years in the late 20th and early 21st centuries, with the number of students taking mathematics at A-Level falling by 28% between 1982 and 2003. By 2003, only 7% of 18-year-olds sat the mathematics A-Level examination (Brown et al., 2008). Part of this decline was due to the introduction of *Curriculum 2000*, whereby the A-Level mathematics subject was split in half with the first year (Grade 12) known as AS-Level and the second year (Grade 13) known as A2-Level, with not all students continuing their mathematics study beyond AS-Level.

In the USA, mathematics is not compulsory in the last two years of secondary school. The structure of their mathematics subjects is different from that of most other countries in that each main content area is a separate subject (e.g., algebra is a subject in its own right). There is also no mandated national or state-based curriculum. Champion and Mesa (2018) found that only 19% of Year 12 students completed a HL mathematics/calculus-based subject in 2009. Furthermore, their data suggested that students' Year 9 mathematics achievement and students' socio-economic status are strongly associated with secondary school calculus completion, disadvantaging minority groups and those students from poorly resourced schools. Additionally, Snyder (2011) reported that the mean number of Carnegie credits (a standard of measurement that represents one credit for the completion of a 1-year course) earned in high school for mathematics in 2005 was 3.7 while the average number of English and social sciences credits students earned stood at 4.4 and 4.0, respectively.

Similar issues with low or declining numbers studying HL mathematics at upper secondary school have also been reported across Europe. For example, in Estonia, high school students are required to pass a minimum of five examinations (three externally set and graded and a minimum of two internally set and graded) in order to graduate from high school. For the externally set examinations, one must be in the subject of Estonian or Russian while the remaining two can be selected from a list of eight other subjects. In 2010, 9.4% of students in their final year of high school chose to study mathematics for these external examinations compared with 16.8% who chose to study English and 13.6% who opted for geography (Hodgen et al., 2010). Similar findings have also been reported in France (Charbannier & Vayssettes, 2009).

## Strategies to address low uptake of HL mathematics

It is now apparent that there has been a trend of low or declining interest from students in choosing, not only HL mathematics, but mathematics in general in upper secondary school. Many countries who report high levels of participation in HL mathematics mandate their students to engage with the study of the subject in upper secondary school. For example, a study carried out by Hodgen et al. (2010) found that countries with the highest rates of participation (more than 31%) in HL mathematics were Japan, Korea, New Zealand, Singapore, and Taiwan. Of these five countries, Japan, Korea, and Taiwan make mathematics compulsory until the end of secondary school. With the exception of Singapore and New Zealand, countries with few or no compulsory subjects have the lowest HL mathematics enrolment numbers.

Rather than making the subject compulsory in upper secondary school, some countries have introduced/trialled strategies to increase the number of students studying mathematics; however, these often have unintended consequences (Treacy et al., 2025) or, even if successful, fall prey to changing government policies and priorities. We will now describe some of these strategies before focusing on a particular incentive introduced in both Australia and Ireland to increase participation in HL mathematics. Such research is needed in order to better understand the effects of mandating or incentivising participation in HL mathematics, including effects on teachers and subsequent participation in HL mathematics at upper secondary level.

In 2006, as a result of the declining number of students studying A-Level mathematics, the UK Government set a target for an increase of 21% in the number of A-Level passes in the subject (Noyes et al., 2011). In order to achieve this goal, they incentivised the study of mathematics post-16 with the introduction of a new A-Level mathematics subject in 2008. This subject was entitled 'Use of Mathematics' and was designed to attract more students to mathematics in Grades 12 and 13 (this subject was previously offered at AS-Level only). Whilst the mathematical content of the 'Use of Mathematics' was very similar to that of the existing A-Level mathematics subject, the priorities were teaching mathematics through applications and modelling (Noyes et al., 2011). When this strategy was introduced, there were concerns expressed by some sectors (e.g. university mathematicians) that enrolment numbers in the existing A-Level mathematics subject would be affected by the introduction of the 'Use of Mathematics' subject; however, this was shown not to be the case (Noyes et al., 2011). Instead, this approach appeared to attract more students to mathematics in Grade 13, with enrolment numbers increasing across most schools which had previously offered the AS version, and in 2013 the overall number of A-Level students studying mathematics across the UK was nearly twice that of 2003. Despite the increase in A-Level enrolment numbers the Government decided to discontinue offering the 'Use of Mathematics' subject, with the last examination held in 2018.

Other strategies introduced in the UK that resulted in an increase in the number of students studying A-Level mathematics in the early 2010s involved increased school funding and a number of fundamental changes to the way mathematics was taught. These included the introduction of 'mastery teaching' (Clapham, 2024) – based on a Singaporean model of teaching that fosters a deeper understanding of the subject – and Maths Hubs, which helped teachers around England share and develop best practice in mathematics teaching (National Centre for Excellence in the Teaching of Mathematics, 2023). The 40 Maths Hubs, spread across England, provide professional development for teachers. Topics have included teaching for mastery; transition from primary to secondary school; mathematical thinking for GCSE; improving teaching approaches for A-Level mathematics; and specialist knowledge for early-career teachers. These approaches, in conjunction with improved appreciation of the power and utility value of mathematics among parents and students, are believed to have contributed to mathematics being the most popular subject for A-Level in 2023 (Noyes et al., 2023).

A different strategy, that has been employed to incentivise the study of HL mathematics in New Zealand and Singapore, is the provision of flexible pathways for students (Treacy et al., 2024). In both of these countries flexibility for students was provided by offering a choice in relation to varying pathways in mathematics. For example, offering students a choice between focusing on calculus or statistics, and a choice in terms of the length of time spent studying the subject by allowing for an extra year to master content and fluency. According to Hodgen et al. (2013) this approach has been successful and the uptake of HL mathematics in both jurisdictions, while not compulsory, is extremely high, standing at over 30%.

Finally, Ireland and Queensland in Australia have introduced similar policies to incentivise the study of HL mathematics. Both policies involve students being awarded additional credit, known in both jurisdictions as bonus points [BPs], if they opt for and pass the HL mathematics course at upper secondary level. It is these incentives that the authors wish to compare and contrast in order to address the following research question:

> How influential are the incentives in place in Ireland and Queensland and how do they impact on students' choice to pursue HL in each jurisdiction?

Due to the aforementioned personal and economic benefits of studying HL mathematics, and the current issues surrounding low uptake of the subject, it is important to develop a good understanding of what motivates students to select HL mathematics and to investigate the benefits and drawbacks associated with incentives used to increase the number of students studying the subject in its most advanced form. While a range of studies have investigated the reasons why students avoid HL mathematics (Norris & Noyes, 2025; Treacy et al., 2024; Hine, 2019; Brown et al., 2008), there is still a dearth of studies into what motivates students to pursue HL mathematics, an issue first noted by Reiss et al. (2011).

Our study aims to address this gap in the literature through a comparative study of the incentivising policies in place in Queensland and Ireland. In both jurisdictions, the uptake of HL mathematics had been shown to be problematic and this led to policymakers introducing BPs for students who studied HL mathematics (Prendergast et al., 2020; Jennings, 2022, 2023). Prior to investigating and comparing the impact of these policies on students' decision to purse HL mathematics, the authors wish to provide an overview of the education system in place in both jurisdictions. We will specifically share some insights into how mathematics education is structured at secondary level, before providing a comprehensive overview of the policies in place to incentivise the study of HL mathematics.

## Context

### Ireland

Secondary education in Ireland is divided into two periods known as 'cycles': lower secondary education known locally as 'Junior Cycle' (students aged 12-15) and upper secondary education known locally as 'Senior Cycle' (students aged 16-18). Junior Cycle is compulsory for all Irish students. There are 28 subjects available for students to study at Junior Cycle and mathematics must be one of the subjects every student studies. At the end of Junior Cycle students must sit a state examination in each of their chosen subjects. Students then progress to a two-year Senior Cycle program where they must study a minimum of five subjects, of which one must be Irish. Students typically study a total of seven subjects and again, at the end of senior cycle, must sit a state examination in each subject. This state examination is known locally as the 'Leaving Certificate' (LC) and is considered an extremely high-stakes examination that dictates which tertiary courses students are eligible to enrol in the following year. Students can opt to take each subject for the LC examination at HL or ordinary level (OL), with more points awarded for grades at HL, as depicted in Table 1.

Table 1: CAO points (CAO, n.d.) awarded for grades achieved in LC examinations

| Examination score | HL | | OL | |
|---|---|---|---|---|
| | Grade | Points awarded | Grade | Points awarded |
| 100% - 90% | H1 | 100 | O1 | 56 |
| 89% - 80% | H2 | 88 | O2 | 46 |
| 79% - 70% | H3 | 77 | O3 | 37 |
| 69% - 60% | H4 | 66 | O4 | 28 |
| 59% -50% | H5 | 56 | O5 | 20 |
| 49% - 40% | H6 | 46 | O6 | 12 |
| 39% - 30% | H7 | 37 | O7 | 0 |
| 29% - 0% | H8 | 0 | O8 | 0 |

Students' grades in their six best subjects are used to calculate their Central Applications Office score (CAO, n.d.) and this score is used to determine their eligibility for tertiary courses of their choice. Prior to 2012, the maximum number of points a student could achieve in any given subject was 100, thus the maximum CAO score they could achieve was 600. Once all students' CAO scores are calculated the number of places available on any given tertiary course is compared with the number of students who have identified that course as their first preference and the minimum points for that course is established. Any student who has achieved this points total, or in excess of it, and meets all minimum requirements in place for the program, are admitted to the program. However, some programs may require students to achieve a certain grade in certain subjects, e.g. a H4 in HL mathematics may be needed for some engineering courses, etc.

Mathematics is not a compulsory subject at Senior Cycle; however, it is treated as such by schools since HL and OL mathematics act as gatekeepers for the vast majority of tertiary courses. As such, virtually all Irish students study mathematics for the LC. This is reflected in annual statistics released by the State Examinations Commission. In June 2024, 56,689 students sat the LC and 56,024 (98.83%) of these students sat a mathematics examination. As such, the uptake of mathematics in Senior Cycle is not problematic in Ireland but the level that students opt to study the subject at has been identified as a cause for concern.

Students in Ireland have the choice to study mathematics at higher, ordinary or foundation level. HL is the most advanced form of mathematics that students can study at Senior Cycle. OL is the next level down. OL covers many of the same concepts addressed at HL but not in the same level of detail. In addition, some topics such as integral calculus and hypothesis testing appear only on the HL course. Foundation level is the third level and is designed for people who struggle with OL. It covers basic mathematical skills. The majority of higher education institutes require Irish students to pass the LC mathematics examination at either the HL or OL in order to progress to tertiary study. In 2011, 15.8% of students opted to study HL mathematics for their LC compared with 63.7% for HL English, 73.4% for HL physics, 81.7% for HL chemistry, 74.7% for HL biology, and 32.2% for HL Irish.

Due to the notable difference in the uptake of HL mathematics when compared with all other subjects, policy makers were keen to find strategies to incentivise the study of HL mathematics. This led to the introduction of the *Bonus Points Initiative* in 2012. Under this policy, students who sit the HL LC mathematics examination and obtain a score greater than or equal to 40% are awarded an additional 25 points, which is added to the points they achieve for the grade they were awarded in the subject of mathematics. This combined total can then be added to their total LC score. As such the maximum number of points a student can now receive in mathematics is 125 compared to 100 points in any other subject that they took at HL. This means the maximum CAO score a student can obtain has also risen, from 600 to 625 points. Furthermore, a student who receives an H6 (40% – 49%) in HL mathematics will now receive 71 points (46 + 25), 15 points more than those available to a student who gets the highest grade at OL (see Table 1).

In order to determine the impact of this policy on the uptake of HL mathematics the authors looked to the State Examinations website (https://www.examinations.ie/) and analysed the change, if any, in uptake of HL mathematics prior to and after the introduction of this policy at both lower and upper secondary level. As mentioned previously, in 2011, prior to the introduction of the BPs, the proportion of students choosing HL mathematics for Senior Cycle stood at 15.8%. The BPs were available to students who sat the LC from 2012 onwards and in this first year this proportion rose to 22.1%. Year on year since, this proportion has risen, reaching 36.3% in 2024 (Figure 1).

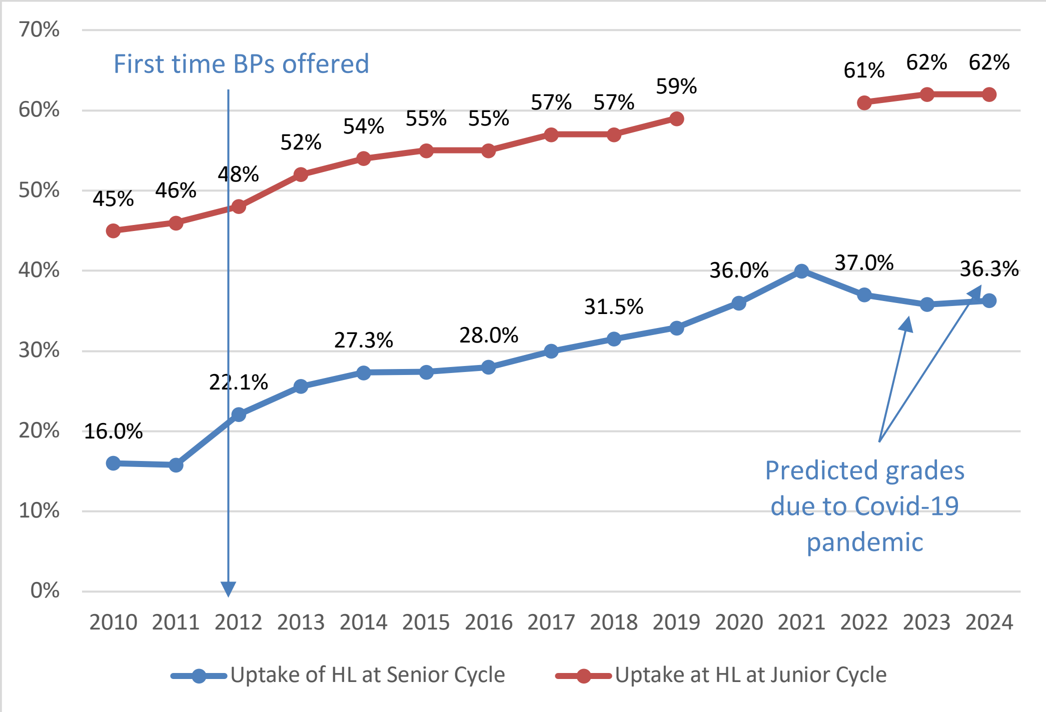


Figure 1: Trends in uptake of HL mathematics in Ireland 2010-2024
Notes: No Junior Certificate examination in 2020 and 2021 due to the Covid-19 pandemic.

During this period there was also an increase, albeit more modest, in the proportion of students taking HL at Junior Cycle, rising from 46% in 2011 to 59% in 2019 (Figure 1). When Junior Cycle examinations were reinstated post-pandemic, this figure continued to rise. However, the increase noted in this time period (2019-2024) could also be attributed to the introduction of a reformed mathematics curriculum at Junior Cycle, a reform effort that saw the removal of foundation level. Despite this, Figure 1 shows that the BPs Initiative undoubtedly enticing more students to pursue HL mathematics at upper secondary level. It is likely to also be motivating a smaller number of students to persevere with HL at Junior Cycle in the hope that they will be able to pursue HL at Senior Cycle and secure the additional BPs.

Coinciding with the introduction of the BPs Initiative in Ireland was the phased introduction of a revised mathematics curriculum at both Junior and Senior Cycle. To determine if the increase in the uptake of HL mathematics at Senior Cycle could be attributed to improved knowledge and performance at Junior Cycle the authors analysed the proportion of students who achieved over 70% in their HL Junior Certificate exam between 2010 and 2019 (we considered results only up to 2019 as the Junior Certificate exam was cancelled in 2020 and 2021 due to the Covid 19 pandemic). The analysis showed that there was very little change in students' performance at Junior Cycle between 2010 and 2019. In fact, the proportion of students receiving over 70% had actually decreased slightly, but not significantly, from 47.0% in 2010 to 43.3% in 2019. Such findings would suggest that improvements in the calibre of student was not driving the surge in uptake of HL that was witnessed at Senior Cycle.

This assertion is also supported by findings from the PISA Mathematics assessment. Irish students' mean scores on the overall mathematics scale were similar in 2003 (502.8), 2006 (501.5), 2012 (501.5), 2015 (503.7), and 2018 (499.6) (Donohue et al., 2023). However, 2009 (487) was much lower than other years but this appears to have been an anomaly. The mean score on the overall mathematics scale in Ireland for 2022 dropped to 491.6 which was a statistically significant decline; however, this was in keeping with trends internationally and was attributable at least in part to significant interruptions to schooling during the Covid-19 pandemic (Donohue et al., 2023). In further research carried out into the BPs Initiative, O'Meara et al. (2020) and McCoy et al. (2019) found that despite the change in the mathematics curriculum at second level in Ireland coinciding with the introduction of the BPs Initiative, teachers and students were unequivocal in their belief that it is the BPs Initiative alone that has resulted in the dramatic rise reported in Figure 1. Prendergast et al. (2020) also found that teachers felt that as a result of the BPs Initiative, many unsuitable students were pursuing HL mathematics and as such 56% of the teachers surveyed recommended a review of the BPs Initiative, while 23% wished the initiative to be stopped. Such findings indicate the need for further evaluation and critique of this policy, and it is this gap in the literature which our paper is addressing.

## Queensland, Australia

Concerns about HL mathematics numbers in Australia have been voiced by several prominent people over recent years, including the Chief Scientist and directors of the Australian Mathematical Sciences Institute (AMSI). The main concerns that have been raised include declining enrolment numbers with negative implications for national productivity in STEM disciplines. In their most recent report Marchant and Kennedy (2024) stated that the proportion of students taking HL mathematics dropped from 14.1% of the Year 12 student population in 1995 to 9.2% in 2021. Intermediate Mathematics numbers have also declined during this period whereas General Mathematics numbers have risen (see Figure 2).

In Queensland, the Australian state of interest for this paper, students begin secondary school (Year 7) at age 12 or 13 and must attend school until they turn 16 or finish Year 10, whichever is sooner. All students study a core curriculum of English, mathematics, science, social science, foreign language, health and physical education, as well as some electives in the later years of junior secondary school. Unlike Ireland, there are no statewide examinations at the end of Year 10. In the final two years of secondary school (Years 11 and 12) students usually study six or seven subjects, with their top five subject results counting towards their university entrance score.

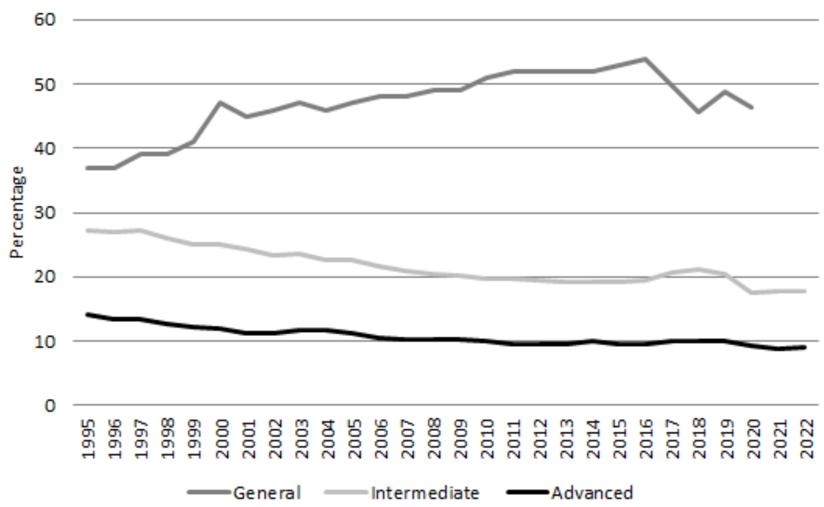


Figure 2: Year 12 Mathematics enrolment numbers as a percentage of Year 12 cohort 1995-2022 (Barrington & Evans, 2016; Marchant & Kennedy, 2024).

Up until the early 1990s, far fewer students in Queensland were staying until the end of Year 12 in comparison to the two other large Australian states, New South Wales and Victoria. In Queensland, the number of students completing Year 12 has risen by 50% since 1992. The main reason for this increase has been a change in Australian Government policy, which now requires students to either be 'learning or earning' – studying at school or working at least 25 hours a week – until the end of Year 12 if they wish to be eligible for Australian Government income support.

Any student who completes Year 12 in Queensland will receive a Senior Education Profile. This is either a Senior Statement detailing their studies and results achieved, or for those who qualify, a Queensland Certificate of Education (QCE). The QCE was introduced in 2008, and one criterion is that a student must have passed at least one semester of mathematics (and English) in Year 11 or 12. In 2009, the first year Year 12 students could receive a QCE, 78% of students received one. In 2016, this figure had risen to 97%, before falling to 93% in 2023 (State of Queensland, 2024).

In Queensland, mathematics is compulsory in the final two years of secondary school in nearly all schools. There are three mathematics subjects that count towards university entry for students to choose from: General Mathematics, Intermediate Mathematics (functions, introductory calculus, and probability), and Advanced (HL) Mathematics (vectors and matrices, real and complex numbers, trigonometry, statistics and calculus). HL mathematics must be taken in conjunction with Intermediate Mathematics. In the mid-1990s, universities across Queensland removed HL mathematics as a prerequisite for entry into engineering degrees, which saw the HL mathematics numbers drop dramatically. The increasing number of subject offerings in Year 11 and 12 has also affected HL mathematics numbers. To arrest and reverse this decline many universities introduced a BPs system in 2006. A student who studies HL mathematics until the end of Year 12 and finishes with a passing grade will receive two BPs towards their university entrance score. These BPs are added to a student's total score (out of 99.95) for all of their subjects at the end of Year 12. During the period 2006-2017, HL mathematics completion numbers rose by more than 63% (see Figure 3). Like Ireland, however, PISA results indicate that the calibre of student entering Year 11 and 12 has not improved as Australia's PISA scores have fallen steadily from 524 to 487 since 2000 (Morsy et al., 2018).

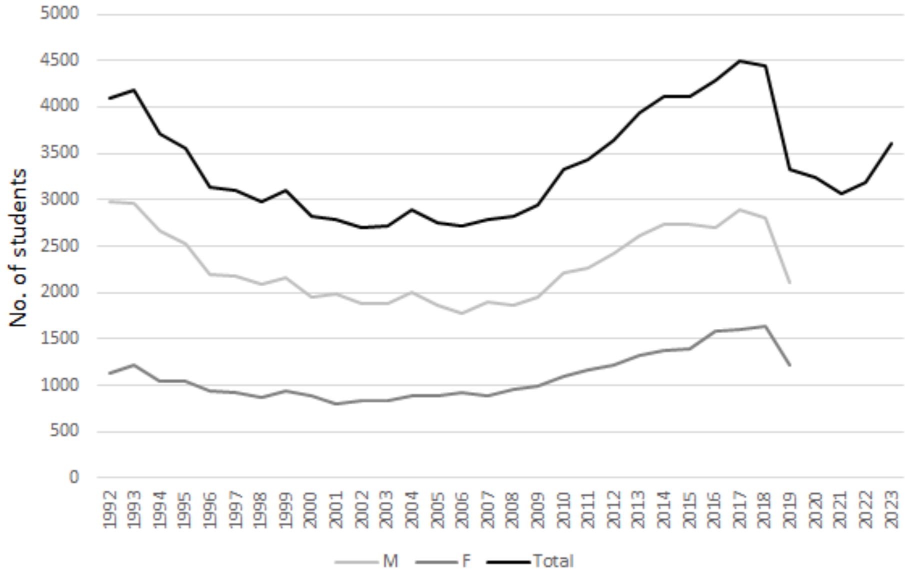


Figure 3: Queensland Year 12 Advanced Mathematics completion numbers 1992-2023 (State of Queensland, 2024).

The large drop in 2019 numbers can be attributed to a change in rules in 2007 regarding the age at which a child can begin school. In 2007 the compulsory Prep year (before Year 1) was introduced, where a child must be at least four and half years old at the start of the school year. This meant that the first Prep cohort was not a full one, hence neither was the Year 12 cohort of 2019.

In 2019, the new Queensland senior secondary system was implemented, with the three previous mathematics subjects replaced by four new ones. External examinations were reintroduced after nearly 50 years of school-based assessment. For mathematics, the external examination is worth 50% of a student's grade. The Year 12 cohort of 2020 was the first to complete school under this new system. Raw numbers of students completing the new HL mathematics decreased in 2020 and 2021. It is also possible that the 2021 numbers were affected by Covid-19. Numbers increased in 2022 and 2023 (see Figure 3). However, some caution is needed to interpret 'raw' enrolment figures because the nature of both secondary and tertiary education has changed immensely during this time. More students are completing all years of secondary school; more are choosing mathematics, although not in numbers that maintain high participation rates overall; many more subjects are available at school, potentially reducing the attractiveness of mathematics as a subject choice; universities have removed many entry prerequisites, including mathematics; and more students are enrolling in university courses.

Therefore, it may be more beneficial to consider the proportion of Year 12 students taking HL mathematics. As shown in Figure 4, between 2006, when BPs were introduced, and 2019, the percentage of Year 12 students opting for HL mathematics in Queensland rose by more than 31%. Following the introduction of the aforementioned external examinations system in 2019, and possibly also as a result of the Covid-19 pandemic, there was a decline in this proportion, but it has begun to rise again since 2021. It is worth noting that Queensland is the only Australian state where there has been long-term improvement in HL mathematics numbers, both raw and as a percentage of the entire Year 12 cohort (see Figure 4). However, it is also notable that the increase since the introduction of BPs is much more modest to that reported in Ireland.

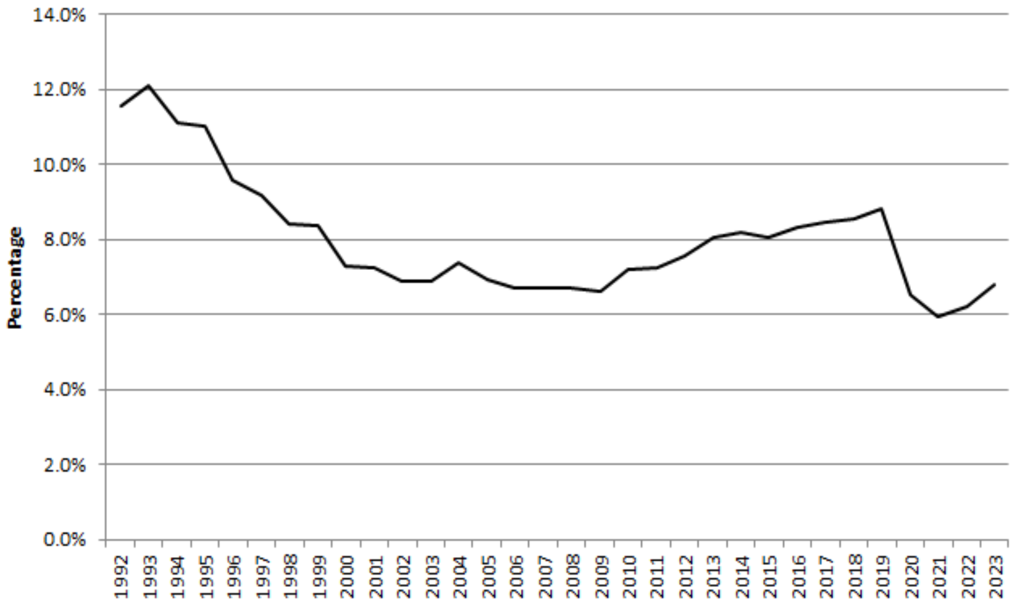


Figure 4: Queensland Year 12 HL mathematics completion numbers as a percentage of Year 12 students 1992-2023 (State of Queensland, 2024).

## Method

### Research design and instrument

As outlined previously, the research question underpinning this study was *How influential are the incentives in place in Ireland and Queensland and how do they impact on students' choice to pursue HL in each jurisdiction?* To address this question, a survey research design was chosen. A survey was deemed to be the most advantageous way for the research team to gather the information required from a large sample of participants, thus ensuring a diverse and representative range of responses. Two similar surveys were designed for distribution in both jurisdictions. In each jurisdiction there was a survey designed for those who opted for HL mathematics and a second survey for those who opted to study mathematics at a less advanced level. The surveys were designed using the "*Maths? Why not?*" survey items (McPhan et al., 2008) as a starting point. In this study we report on the findings from the survey distributed to those students who opted to study HL mathematics.

This survey contained two sections. In Section A information was gathered in relation to participants' demographics and current year of study as well as the level of mathematics they had studied and the grade they had achieved at lower secondary level (Ireland only). In Section B participants were provided with nineteen potential reasons, identified and validated in the literature, for opting to study HL mathematics and asked to state, on a five-point Likert scale, from *strongly agree* to *strongly disagree,* if they agreed or disagreed that the reasons played a role in their motivation. Participants were also asked to outline any other motivating factors that influenced their decision and to identify the reason, from those listed, that was most influential in their decision to undertake HL mathematics. The wording for two items on the survey differed between the two jurisdictions to reflect the slightly different contexts. For example, Reason 8 on the Australian survey read "It will give me a good OP score" while on the survey for Irish students this read as "I will get good CAO points from it".

**Sample and data analysis**

In both jurisdictions ethical approval was granted by the relevant university ethics and school education boards and convenience sampling was then employed. In Ireland seven secondary schools and five vocational schools[1] were invited to participate so that the breakdown of school types in the sample was aligned with the national breakdown. While all schools initially accepted the invitation, two schools subsequently withdrew resulting in the final Irish sample consisting of three vocational schools and seven secondary schools. Across these schools, 1706 senior cycle students responded to the survey and 53.4% ($n$=911) of the sample were studying HL mathematics. These 911 students constitute the Irish sample. The Queensland sample was made up of 350 HL mathematics students from 37 schools spread across the state. The schools were representative of system (public, Catholic, and independent) and location.

The quantitative data was entered into a SPSS (version 25) file for analysis. Descriptive tables and graphs were then computed for both jurisdictions to determine the key factors that motivated students in both jurisdictions to pursue HL mathematics. The statistical package SPSS was also used to calculate a Cronbach's alpha of 0.794, which indicates the survey items were reliable.

[1] In Ireland the majority of secondary schools are classified as either secondary or vocational schools. Secondary schools are privately owned and managed. They are under the trusteeship of religious communities, boards of governors, or individuals. Vocational schools are owned and run by local Education Training Boards.

## Findings

To investigate the impact of the BPs Initiative, students were asked to rank, on a five-point Likert scale, which of nineteen factors were most influential in their decision to study HL mathematics. The results from this survey item for Irish students are presented in Table 2.

Table 2: Irish students' reasons for pursuing HL mathematics ($n$ = 911)
Note: shading indicates a top five response

| | Item: I chose higher level because… | Strongly agreed/ Agreed | Neutral | Disagreed/ Strongly disagreed |
|---|---|---|---|---|
| 1 | … I find mathematics at Junior Cycle interesting. | 573 (63%) | 185 (20%) | 153 (17%) |
| 2 | … I like mathematics. | 561 (62%) | 171 (19%) | 177 (20%) |
| 3 | … I am good at mathematics. | 420 (46%) | 307 (34%) | 183 (21%) |
| 4 | … mathematics is my best subject. | 140 (15%) | 168 (18%) | 599 (66%) |
| 5 | … I think I will get good teachers. | 469 (52%) | 319 (35%) | 117 (13%) |
| 6 | … I think I will get good marks. | 459 (51%) | 340 (37%) | 110 (12%) |
| 7 | … it sounded interesting. | 342 (37%) | 301 (33%) | 262 (29%) |
| 8 | … I will get good CAO points from it. | 730 (80%) | 142 (16%) | 36 (4%) |
| 9 | … it will help me in everyday life. | 298 (33%) | 231 (25%) | 375 (42%) |
| 10 | … my Junior Cycle mathematics teacher suggested I do it | 392 (43%) | 288 (32%) | 226 (25%) |
| 11 | … another teacher suggested I do it | 188 (21%) | 331 (36%) | 391 (44%) |
| 12 | … the career guidance teacher suggested I do it. | 187 (21%) | 323 (36%) | 397 (44%) |
| 13 | … my parents suggested I do it. | 667 (73%) | 117 (13%) | 125 (14%) |
| 14 | … my friends suggested I do it. | 338 (37%) | 295 (33%) | 276 (30%) |
| 15 | … my siblings suggested I do it. | 321 (36%) | 271 (30%) | 316 (35%) |
| 16 | … all of my friends were doing it. | 214 (23%) | 230 (25%) | 462 (51%) |
| 17 | … I need higher level mathematics for my university course. | 400 (44%) | 222 (25%) | 281 (31%) |
| 18 | … it doesn't seem like it would be too much work. | 90 (10%) | 120 (13%) | 699 (67%) |
| 19 | … I wanted to get the bonus points | 830 (91%) | 58 (6%) | 22 (2.5%) |

As shown in Table 2, in Ireland the five factors from the list of nineteen which motivated students to study HL mathematics more than any others were: I wanted to get bonus points; I will get good CAO points from it; My parents suggested I do it; I find mathematics interesting; I like mathematics.

The responses to similar statements put to students in Queensland, Australia, are presented in Table 3.

Table 3: Australian students' reasons for pursuing HL mathematics (*n* = 350)
Note: shading indicates a top five response

| | Item. I chose AM because… | Strongly agreed/ Agreed | Neutral | Disagreed/ Strongly disagreed |
|---|---|---|---|---|
| 1 | … I found mathematics interesting in junior secondary school. | 256 (78%) | 51 (15%) | 23 (7%) |
| 2 | … I like mathematics. | 279 (84%) | 43 (13%) | 10 (3%) |
| 3 | … I am good at mathematics. | 270 (85%) | 43 (13%) | 8 (3%) |
| 4 | … I thought I would get good teachers. | 182 (57%) | 114 (35%) | 27 (9%) |
| 5 | … I think I will get good marks. | 227 (69%) | 76 (23%) | 23 (7%) |
| 6 | ... there were no other subjects on the same line that I wanted to study. | 82 (25%) | 73 (23%) | 167 (52%) |
| 7 | … it sounded interesting. | 252 (76%) | 60 (18%) | 18 (6%) |
| 8 | … it will give me a good OP score. | 254 (77%) | 56 (17%) | 17 (5%) |
| 9 | … it will be good for my life. | 178 (54%) | 104 (31%) | 49 (15%) |
| 10 | … it was what my maths teacher suggested. | 113 (35%) | 135 (41%) | 82 (24%) |
| 11 | … it was what other teachers suggested. | 74 (23%) | 157 (48%) | 99 (30%) |
| 12 | … it was what the careers/guidance counsellor suggested. | 57 (18%) | 146 (45%) | 124 (38%) |
| 13 | … it was what my parents suggested. | 142 (44%) | 112 (34%) | 71 (22%) |
| 14 | … it was what my friends suggested. | 73 (23%) | 135 (42%) | 115 (36%) |
| 15 | … it was what my siblings suggested. | 50 (15%) | 135 (42%) | 136 (43%) |
| 16 | … I need it for what I want to do at uni. | 145 (44%) | 98 (30%) | 84 (26%) |
| 17 | … my friends were going to do it. | 91 (27%) | 102 (31%) | 134 (41%) |
| 18 | … it doesn't seem a lot of work. | 20 (6%) | 58 (18%) | 246 (76%) |
| 19 | … there are no essays. | 117 (36%) | 84 (26%) | 125 (38%) |

As outlined in Table 3, the top five reasons given by Australian students as to why they pursued HL mathematics are: I am good at mathematics; I like mathematics; I found mathematics interesting in junior secondary school; It (AM) would give me a good university entrance (OP) score; It sounded interesting.

In order to compare the responses across the two jurisdictions the authors took the five most popular responses from each jurisdiction and compared the level of agreement to each statement (Figure 5).

The top three reasons given by Irish students indicate that external factors are the key motivators for them opting to study HL mathematics. Figure 5 indicates that extrinsic motivation is much higher among Irish students compared to their Australian peers. For example, a higher proportion of Irish students were motivated by the points on offer for HL mathematics compared to Australian students. On the other hand, the most agreeable factor for Australian students (*I am good at mathematics*) related to their positive levels of self-belief in their mathematical ability, but no reasons related to self-belief or self-efficacy featured in the top five reasons for Irish students. Instead, Figure 5 shows a stark difference in the proportion of students who agreed/strongly agreed with the statement *I am good at mathematics*. In Australia, 85% of students surveyed agreed/strongly agreed that this was an influential factor in their decision compared with 46% of Irish students.

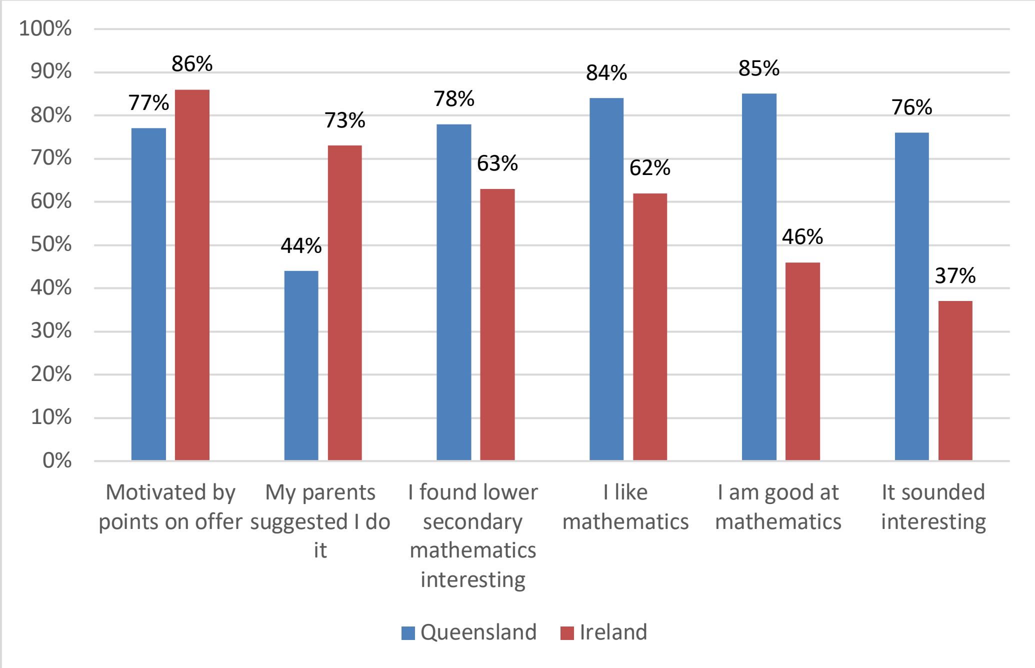


Figure 5: Proportion of students who agreed or strongly agreed with the most popular reasons across both jurisdictions

Furthermore, intrinsic motivation factors made up three of the five factors stated by Queensland students while two of these factors (*I like mathematics,* and *I find mathematics interesting*) were among the top five most popular factors in Ireland. However, Figure 5 shows that there were much stronger levels of agreement with these intrinsic motivation factors in Australia compared to Ireland. For example, in Australia 84% of students agreed/strongly agreed that they chose HL mathematics because they liked mathematics while this proportion stood at 62% in Ireland. Similar differences can be seen in Figure 5 for the statements *I found lower secondary mathematics interesting* and *It sounded interesting.* Additionally, of the items regarding the influence from people in a student's network, as was the case in Ireland, parents had the strongest influence in Australia; however, it was only at the 44% agreement level in Australia compared to 73% in Ireland. The findings reported here show significant differences in the reasons behind students' decision to pursue HL mathematics in both jurisdictions, despite the presence of BPs in both regions.

## Discussion

Encouraging more students to engage in advanced mathematics during and after secondary education remains a consistent challenge for education systems globally (Brignell et al. 2025; Hine et al. 2024). This study aimed to explore how incentives in Ireland and Queensland influence students' choices to pursue HL mathematics at secondary level in each region. In Queensland, numbers completing HL mathematics rose by more than 63% after many universities introduced a BPs system in 2006. However, there has been a drop in these numbers in recent years since the introduction of a new Queensland senior secondary system in 2019 which saw assessment change to a mixture of school-based and external examination assessment. In Ireland, the proportion of students taking HL mathematics for the LC has more than doubled (15.8% in 2011 to 36.3% in 2024) since the BPs Initiative came into effect in 2012. With this in mind, it is little surprise that 46% of Irish students cited the BPs Initiative as their primary motivator to study HL mathematics. While 91% strongly agreed/agreed that they '*wanted to get bonus points*', only 62% agreed that they '*like mathematics*'. On the other hand, intrinsic motivation factors made up four of the top five factors stated by Queensland students. For example, 84% of this cohort of students agreed that they chose HL mathematics because they '*like mathematics'*.

As such, findings from this study indicate that there are considerable differences in the motivations behind students' decision to pursue HL mathematics in Ireland and Queensland. This is despite the initiatives introduced in both jurisdictions to increase the uptake of HL mathematics appearing quite similar. While this study has shown that both initiatives have acted as a motivational factor for students to pursue HL mathematics, the findings evidence that Irish students are much more likely to be extrinsically motivated by such initiatives than their Australian peers. From an Irish perspective, this raises some concern as, over time, extrinsic motivators have been found not to work (Adamma, Ekwutosim & Unamba, 2018). Furthermore, Biehler and Snowman (1990), determined that the presence of extrinsic motivational factors can lead to diminished intrinsic motivation among students. Such findings suggest that the influence of the Irish BPs Initiative on students' decision to pursue HL mathematics may in fact have unintended negative effects on students' affective reaction to the subject. This raises the question, if Ireland were to abandon the initiative, would we see a lower proportion of students opting for HL mathematics than when the initiative first came into effect in 2012?

Given the findings of this study, it is important to consider the reasons why the incentives in Ireland and Queensland have had differing impacts in terms of motivation. The most obvious explanation is the different weighting of the BPs in each jurisdiction. In Queensland, a student who studies HL mathematics until the end of Year 12 and finishes with a passing grade will receive two BPs towards their university entrance score. This is two points added to a student's total Year 12 score out of 99.95. In Ireland, however, the weighting on the BPs Initiative is much higher. Irish students who sit the HL LC mathematics examination and obtain a score greater than 40% are awarded an additional 25 points which is added to the points they achieve for the grade they were awarded in the subject of mathematics. As such the maximum number of points a student can now receive in mathematics is 125 compared to 100 points in any other subject that they take at higher-level.

In order to highlight the impact that this difference in weighting has, we can consider the entry requirements for similar courses in both jurisdictions. In Queensland, one of the most popular degrees at The University of Queensland, the Bachelor of Engineering, has an entry score in 2025 of 84. A student with a score of 82 could enter this degree using their BPs, so the BPs represent 2.4% of the total points needed for entry. The combined

Bachelor and Master of Engineering degree has an entry score of 97, so the two BPs represent 2.1% of the total points needed. For a Bachelor of Arts (entry score 70), the BPs represent 2.9%. In general, the two BPs represent between 2 and 3% of the total points a student needs to gain entry into their desired degree program.

In Ireland, to enrol in the B.A. Engineering at Trinity College students require a points total of 556 and so the 25 BPs on offer represents 4.5% of the total points needed. Likewise, for a Bachelor of Arts program in the University of Limerick, the points required in 2024 were 316 so the BPs available represent 7.9%. This highlights how the BPs in Ireland have a much more influential role in helping students secure elusive places on tertiary programs. Thus, the attraction of BPs is compelling even those students who struggle with mathematics to study it at advanced levels in Ireland (O'Meara et al., 2020; Prendergast et al., 2020; O'Meara et al., 2023). For many, it is a question of whether the risk of passing the HL LC examination in Ireland outweighs the risk of failing it. For example, a student who achieves 90-100% in the Ordinary-Level (OL) mathematics examination is awarded 56 CAO points. If the same student achieves the lowest passing grade in the HL mathematics paper (40-49%), they are awarded 46 points and the additional 25 BPs, resulting in a total of 71 LC points. In addition to this, the introduction of points for what is perceived as a failing grade, H7, in 2017 has lowered the risk of failing (McCoy et al., 2019). While there remains a danger of failure, the findings of this study suggest that many students see it as a risk worth taking.

Thus, while policy makers in Queensland may need to consider increasing the BPs to encourage more students to take HL mathematics, Irish policy makers also have decisions to make about the future of the BPs Initiative. The results of Prendergast et al. (2020) indicated that the majority (56%) of Irish mathematics teachers would like to see the BPs Initiative retained but adjusted in some way. The most popular adjustment would be for the points to be awarded on a scale which is in line with the mathematics grade achieved. In its current form, the BPs Initiative gives the same reward of 25 extra points regardless of whether a student has scored 100% or 40% in their LC HL mathematics examination. Adjusting the points system might discourage borderline students from taking the risk of barely passing the exam, while still recognising those who do for the additional time and effort invested in HL LC mathematics. The second most common adjustment mentioned by teachers in Prendergast et al. (2020) was that BPs should only be awarded for higher grades. The current system sees points awarded when students achieve at least 40% at HL. This has certainly incentivised students, who would have typically sat the OL examination, into taking a 'calculated risk'. Both of these suggestions would certainly entice high achieving students who know they can be successful, as well as reducing the number of students who are solely targeting 40% in order to get 25 extra points. However, while it was initially designed to be a temporary measure in Ireland, there are currently no indications that the policy will be discontinued or altered in any manner.

Another finding of note is the influence of parents. In Queensland, of the items regarding the influence from people, parents had the strongest influence at 44% agreement level. In Ireland, this influence was significantly stronger, with 73% of respondents either agreeing or strongly agreeing that the reason they were studying HL mathematics was because *My* *parents suggested I do it'.* This parental influence is a noteworthy finding and has long been established in the literature. For example, Bourdieu and Passeron (1977) emphasised the influence of families' social, economic and cultural capital in shaping students' educational choices. Turner and Lapan (2002) found that parental support increases students' confidence to explore options, including options that they may previously have thought to be inaccessible. However, parental engagement is not the same for all. Studies examining the effect of socio-economic status on parental involvement indicated that low-income parents were less involved in their children's education than high-income parents (Heymann & Earle 2000).

From an Irish perspective, Lyons et al. (2003) conducted a study that highlighted the variety of cultural capital, social capital and economic capital that parents possessed and how they made use of it. In their study, they categorised the parents as "Insiders", "Intermediaries" and "Outsiders". Insider parents were characterised by their comprehensive knowledge of the education system, their own high levels of education and the interventions they made with regard to their children's education. Intermediary parents represented those who were between the Insider and Outsider group and while they understood certain aspects of the education system, they did not have the cultural or financial resources of the Insiders. The Outsiders are described by Lyons et al. (2003) as being "outside the system" and characterised by lower levels of knowledge of the education systems, lower education levels and low levels of intervention. Given the importance of parental influence in children studying HL mathematics, it is important to be aware of how this factor has the potential to further exacerbate educational inequalities. Unfortunately, this is only the tip of the issue, especially given the growing popularity of private supplementary tutoring for those studying higher level mathematics (Prendergast & O'Meara, 2024). It is obvious that wealthier families have the means to afford more regular and higher-quality tutoring compared to families with lower incomes (Bray & Hajar, 2023). In line with parental influence, this creates a gradient of educational advantage for studying HL mathematics that correlates with family wealth.

## Conclusion

In conclusion, this study highlights the effectiveness and implications of incentive-based policies aimed at increasing the uptake of HL mathematics in two jurisdictions. The comparative analysis revealed significant differences in student motivations across the two jurisdictions, with Irish students primarily driven by extrinsic rewards such as BPs, while Queensland students exhibited stronger intrinsic motivations rooted in interest and self-efficacy. This is despite the incentives on offer in both jurisdictions appearing quite similar. These findings underscore the need to evaluate the long-term impact and consider the unintended consequences of policies to incentivise the study of HL mathematics and consider how subtle differences in these policies can yield different outcomes for education systems. Ireland's BPs Initiative, though successful in boosting enrolments, raises concerns about its unintended consequences, including the potential for diminished intrinsic motivation and challenges for teachers catering for a broader range of student abilities. Conversely, Queensland's approach, with a lighter emphasis on BPs, has fostered more sustained intrinsic interest among students, suggesting that a more balanced or nuanced incentive model may yield better outcomes.

Policymakers internationally could benefit from lessons learned in this study. The results help to highlight the merit of scaling BPs based on achievement levels to maintain engagement without encouraging undue risk-taking. Additionally, the findings from the analysis of Queensland students' responses would encourage policy makers to explore modest enhancements to the bonus system on offer to further bolster enrolments. Ultimately, for any country looking to increase participation in mathematics at upper secondary level, fostering a love for mathematics should remain a central goal, complemented by carefully crafted policies that support both student motivation and academic success.

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**Dr Niamh O'Meara** is an Associate Professor in Mathematics Education in the School of Education at the University of Limerick, Ireland. She is also the Deputy Director of EPI·STEM, the National Centre for STEM education. She is a qualified mathematics teacher and her research interests include mathematics teacher knowledge, curricular issues in mathematics education, numeracy education and improving attitudes and performance in mathematics.
ORCID: https://orcid.org/0000-0002-6959-2783
Email: niamh.omeara@ul.ie

**Dr Michael Jennings** is a Lecturer in Mathematics at The University of Queensland in Brisbane, Australia. His research interests include students' transition from high school to university mathematics, as well as the teaching and learning of first-year university mathematics. Michael is a former mathematics and Japanese secondary school teacher.
ORCID: https://orcid.org/0000-0001-6219-0776
Email: msj@uq.edu.au

**Dr Mark Prendergast** is a Senior Lecturer in Education in the School of Education at University College Cork, Ireland. He is a qualified secondary level mathematics teacher. At tertiary level, his teaching and research interests include mathematics education, teacher education, and adult numeracy.
ORCID: https://orcid.org/0000-0002-1766-7421
Email: mark.prendergast@ucc.ie

**Dr Páraic Treacy** is a Lecturer in Mathematics in the school of Education at Mary Immaculate College (Thurles), Ireland. His qualifications include a PhD in Mathematics Education, BSc in Physical Education and Mathematics, and a Senior Fellowship of the HEA (UK). His research interests include integrated STEM education, mathematics education and mathematics assessment methods.
ORCID: https://orcid.org/0000-0002-6447-1798
Email: paraic.treacy@mic.ul.ie

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