BONUS TERRITORY:

The Shifting Landscape of Higher Level Senior Cycle Mathematics (2010-2024)

EPI·STEM

National Centre for STEM Education

MIC MARY IMMACULATE COLLEGE COLÁISTE MHUIRE GAN SMÁL

UCC University College Cork, Ireland Coláiste na hOllscoile Corcaigh | School of Education

UNIVERSITY OF LIMERICK OLLSCOIL LUIMNIGH | School of Education

Páraic Treacy (School of Education, Mary Immaculate College),
Mark Prendergast (School of Education, University College Cork), and
Niamh O'Meara (EPI·STEM, School of Education, University of Limerick)

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Preface

It is an honour to be invited as Professor of STEM Education, and as Director of EPI•STEM The National Centre for STEM Education to write the Preface for this detailed and timely national policy report and research study into the changing participation rates in Senior Cycle Higher Level Mathematics in Ireland. The study examines the participation landscape from 2010 to 2024, and also takes into account the perspectives of mathematics teachers and students in more recent times and the perspectives of policymakers (website interrogation of the State Examinations Commission).

This national policy report draws together a substantive evidence base to make the case for a timely review of the issue of Higher Level mathematics in Senior Cycle and provides the reader with three importance findings in relation to (1) student motivation (2) teacher preparation and continuing professional learning and (3) the maintenance of standards in mathematics. The study shows that the increase in the number of students participating in Higher Level Mathematics in Senior Cycle has been a resounding success from a numerical perspective. The evidence points toward a strong extrinsic motivation for the students. This appears to have a problematic effect in relation to teaching mathematics for understanding and pedagogical inclusion. There are serious concerns raised in relation to the drop in national standards, worrying trends that are also found elsewhere.

The insights and evidence from this study will be of great interest to a wide number of policymakers, and will help to shape a futures-oriented view of the important role of Mathematics Education and STEM Education in a fast-changing world. In a highly technological and scientific world there are multiple purposes at individual, societal, economic and environmental levels for achieving success in advanced mathematics. While identification of the talent pool for assuring a thriving economy and for national security are well rehearsed, of equal importance today is the successful development of an equitable, well-educated and sustainable society and environment.

Besides all of the above, the topic itself is close to my heart for several reasons. I only managed to access and achieve in Higher Level mathematics in Leaving Certificate because a boy from a wealthy background came to our school to repeat his Leaving Certificate to get the points for medicine. The mathematics teacher decided to add me to his class, making a sum total of two pupils. Later when I taught Higher Level mathematics in Senior Cycle to young people in Coláiste Iognáid SJ in Galway, I found that often the girls were far quicker than the boys to want to drop out. By happenchance, I read a book by the Stanford Professor Jo Boaler at that time that showed me the often hidden assumptions and cultural reasons behind many of these decisions. This opened my eyes to what I could do differently and also the complexity and multifaceted nature of the problem. Later during my PhD in Comparative Education in Trinity College in 2009, working with mathematics teachers in upper secondary in Ireland and Norway, I gained a deeper insight into the importance of continuing professional development, upskilling and resourcing of mathematics teachers.

This study is timely given the recent emphasis by the European Commission in 'open schooling' and the need for new sustainable and transformative partnerships that will bring about a more equitable and sustainable green and digital transition in Ireland and across Europe. The policy imperative to constructively critique and accurately name where we have arrived at today is of crucial importance for future decision-making in policy and practice. This national policy report manages to do just that.

Professor Geraldine Mooney Simmie

Professor of STEM Education
Director of EPI•STEM The National Centre for STEM Education
School of Education, Faculty of Education & Health Sciences
University of Limerick

Foreword

I am honoured to write a Foreword to this important report, *Bonus Territory: The Shifting Landscape of Higher Level Senior Cycle Mathematics (2010-2024)* by Drs Niamh O'Meara, Mark Prendergast and Páraic Treacy. The report is based on their collaborative research into the effect of the Bonus Points Initiative (BPI) on participation in Higher Level Senior Cycle Mathematics and related issues. I am delighted to be associated with this major empirical study on the impact of the BPI on post-primary mathematics in Ireland.

My own career has been enhanced by an ongoing academic and personal relationship with the authors since our paths crossed when first they were preservice teachers, then doctoral students, and ultimately valued academic colleagues and friends working in Higher Education. Working together over a number of years, they have produced an impressive output of high quality research papers on topical issues in mathematics education.

Improving participation in Higher Level Senior Cycle Mathematics has been a longstanding priority for the Department of Education and the Government. The stakes are high for all stakeholders and success leads to highly valued rewards for individuals and society. There is universal agreement that Mathematics underpins all the STEM and numerate disciplines. Therefore, more students achieving better and more advanced mathematics is a highly prized system outcome, e.g. leading to good preparation for STEM disciplines in Higher Education (HE), and on to economic success and national prosperity. However, as the authors demonstrate through meticulous research, the prize has a high price tag.

I am sure you, the readers, will agree that this report represents an important and significant body of research, which is the culmination of the authors combined efforts over a number of years. The report, working from a solid evidence base, confirms and underlines how successful the BPI has been, but also points to a downside viz. higher participation rates have serious unexpected consequences for mathematics teaching and learning at Senior Cycle *and* Junior Cycle. The report investigates the issues from three vantage points, and identifies and explores unexpected consequences offering insights and proposals for consideration.

The authors highlight issues posed by the significant change in the profile of a typical Higher Level Senior Cycle Mathematics cohort, and show that the motivational value of the bonus points is mainly extrinsic for the new entrants, raising questions about the value of such motivation and its long-term duration and effect on students. Alongside this, mathematics teachers are experiencing new challenges dealing with a wider range of abilities in their advanced mathematics classes, and some are ill prepared. There is concern that the multiple issues identified contribute to a decline in standards over the years examined in the report. While these issues are problematic, the researchers adopt a positive approach offering insightful discussion and workable proposals to address the issues in the future.

This report is essential reading for policy makers and all other stakeholders in Irish education. The authors offer evidence and insights confirming the success of the BPI, and in addition, address issues that have arisen because of this important far-reaching initiative. This is an important contribution to the ongoing debate concerning incentivising participation in this way.

The authors, by bringing their work together in a well-researched and insightful report, have made their findings accessible to a wider readership nationally and internationally, while catering for a primary readership of policy makers, practitioners, teacher educators, and mathematics/STEM education researchers.

Professor (Emeritus) John O'Donoghue
EPI•STEM The National Centre for STEM Education
University of Limerick

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We also acknowledge the vital contributions of the teachers and students who agreed to participate in this research.

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Executive Summary

Increasing participation in Higher Level mathematics at Senior Cycle (upper secondary level) in Ireland has been a key aim for policymakers in the past 15 years (Department of Education and Skills, 2011). The transformation in curricula at Junior Cycle (age 12-15) and Senior Cycle (age 16-18) during this period coupled with the introduction of an incentive, commonly referred to as 'bonus points', are indicators of the enhanced focus placed on mathematics. The Bonus Points Initiative (BPI) enables those studying Senior Cycle mathematics at the most advanced level (Higher Level) to gain an extra 25 points should they achieve a passing grade or better. This is in addition to a maximum of 100 points which they can achieve based on their final grade. The BPI has proven to be a significant factor in increasing the proportion of students opting to complete their Senior Cycle mathematics studies at Higher Level from 15.6% in 2011 to 36.3% in 2024 – an increase of 129.7%.

The BPI, introduced in 2012, achieved an important aim policy makers had at the outset of increasing the proportion of students opting to complete mathematics at Higher Level for Senior Cycle to 30% by 2020. In fact, this level of participation was achieved by 2017. Clearly, participation in Higher Level mathematics has grown significantly since the introduction of the BPI, however, this has had some negative impacts on teacher experiences in the classroom, student motivation to engage meaningfully with mathematics, and standards for achievement in mathematics at Senior Cycle.

This report brings together in a single volume findings and insights based on a number of themed studies related to the BPI conducted by the authors. The purpose of the report is to add to the evidence base in this area to assist policy makers and stakeholders in their endeavours to improve the mathematics experience of Senior Cycle students particularly, and post-primary students in Ireland generally. In the report, the authors examine the impact significant changes in participation in mathematics at this level has had on both teachers and students, as well as the wider implications for the education system in Ireland.

Data which informed the current study were gathered through a student questionnaire, a teacher questionnaire, and the collation of data from the State Examinations Commission (SEC) website. The teacher questionnaire was distributed to teachers in a nationally representative sample of 400 schools, with responses from 266 Senior Cycle Higher Level mathematics teachers. The student questionnaire was completed by 1702 Senior Cycle students, 911 of whom were studying Higher Level mathematics at the time. The final grades of 667,687 students who completed their Leaving Certificate mathematics examinations during the period 2008-2024 were included in the database sourced from the SEC.

Our research highlights three important areas for consideration, each of which are interlinked:

- **The profile of students in a typical Higher Level Senior Cycle mathematics cohort** has changed significantly, as many more students that would typically have opted for Ordinary Level mathematics before the introduction of the BPI are opting to take on the challenge of Higher Level mathematics. The most common motivational factors for these students to study mathematics at this level appears to be extrinsic in nature. Achieving a passing grade (40% or better) is enough to earn the full complement of bonus points (25 extra points) on offer and this has been signposted as the most important factor by the majority of students in their decision to opt for Higher Level mathematics.

- **Teachers of Higher Level Senior Cycle mathematics** are experiencing significant challenges in relation to catering for widening ranges of achievement in their classrooms. An increasing number of their students require extra support leading to a reduction in the pace of learning and greater demands on teachers' time and energy. Teachers have also expressed concerns that opportunities to engage in more challenging material are limited and, as a result, worry that their higher attaining students may not be challenged sufficiently.

- **The standards linked to grades** awarded upon completion of Senior Cycle Higher Level mathematics appear to have declined in the past 15 years. Like many of their international counterparts, the education system in Ireland adopts a policy of 'attainment referencing' which typically maintains the proportion of students achieving the given grade levels in a subject from year to year. With the significant growth and transformation in a typical Higher Level Senior Cycle mathematics cohort, maintaining relatively similar grade attainment levels led to a greater number of students achieving grades at the upper end when compared to previous cohorts. Therefore, it has become less of a challenge to achieve these higher grades and, thus, standards in mathematics appear to have declined as a result.

These findings indicate that while measures such as the BPI appear to work well on the surface, they need to be adopted with care and consideration for the broad range of consequences, intended and unintended, that they may have on a variety of stakeholders. A set of recommendations are outlined below to address the key findings of this report as well as considerations for how to effectively widen and enhance participation in Higher Level mathematics at Senior Cycle:

- **Policy makers should re-assess the nature of bonus points** to reduce the incentive to aim for a low passing grade. They should link the number of bonus points awarded to the grade achieved, i.e. reward higher grades with a greater number of bonus points. In tandem, more focus should be placed on interventions which enhance students' attitudes towards mathematics, thereby boosting intrinsic motivation to study the subject at Higher Level. This would be preferable to policies which aim to enhance extrinsic motivation such as bonus points (in their current form).

- **The Department of Education should provide continuous professional development** for post-primary mathematics teachers to enhance their skills in differentiated instruction and supporting struggling students. Consideration needs to be given to how teachers and students may be effectively supported as they adapt to the challenges of Higher Level mathematics, particularly in light of the changing nature of typical Senior Cycle mathematics cohorts at this level.

- **Further funded research through appropriate agencies is needed** to establish the breadth and impact of barriers to studying mathematics at Higher Level in post-primary schools, including gender differences and mathematics anxiety, in order to address these barriers effectively.

- **The State Examinations Commission (SEC) should review the grades awarded** in Higher Level Senior Cycle mathematics to establish the level of grade inflation and the impact this has on Higher Education as well as the overall standards of post-primary mathematics. Further research on the impact of this grade inflation on stakeholders in Higher Education should be conducted in order to gauge the downstream impact.

Improving the overall achievement of upper secondary level students in mathematics in any education system is a significant task which has no easy solution. It is a multifaceted challenge which is fraught with a range of barriers. Exploring methods for incentivising the study of advanced mathematics such as the BPI is understandable but warrants a cautious approach. The findings detailed in this report provide insights into the potential pitfalls inherent in such an endeavour and the lessons which can be learned in this context.

1. Introduction

1.1 Advanced Mathematics Participation in Ireland

Increasing participation in advanced mathematics up to and beyond the completion of secondary mathematics is a persistent challenge for education systems worldwide (Brignell et al., 2025, Hine et al., 2024). Reasons cited for enhancing the overall mathematical capabilities within a society often include the impact on the economy, the cultural impact of learning mathematics for its own sake, and the development of key skills to aid critical thinking in everyday life (Noyes et al., 2023).

In 2017, the Department of Education and Skills (2017, p.12) in Ireland set the goal of being "internationally recognised as providing the highest quality STEM education experience for learners that nurtures curiosity, inquiry, problem-solving, creativity, ethical behaviour, confidence, and persistence" by the year 2026. Such an ambitious goal was established in the wake of a period of significant changes to the Junior Cycle (ages 12-15) and Senior Cycle (ages 16-18) mathematics curricula in Ireland. These revised curricula, introduced on a phased basis from 2010 onwards, aimed to place greater emphasis on student understanding of mathematical concepts by utilising appropriate contexts and applications of mathematics in real world situations (Department of Education and Skills, 2010).

An incentive to study Higher Level mathematics for Senior Cycle – commonly referred to as 'bonus points' – was also announced in 2010 and came into effect for those completing Leaving Certificate examinations in 2012 and beyond. The Bonus Points Initiative (BPI) ensured that students who achieved a passing grade (≥40%, D3 grade or better at the time, H6 grade or better currently) would be awarded 25 points in addition to the points achieved for their grade. Students can achieve a maximum of 625 CAO (Central Applications Office) points at the end of Senior Cycle from up to 6 subjects. Each student's points total is vital in determining whether or not they gain access to their desired Higher Education course in Ireland. Thus, the BPI is an important factor to be considered by students when deciding upon the level of mathematics they opt to study. The BPI has been retained since its inception with no formal evaluation of the initiative. There has also been no official indication that it is to be adapted or discontinued.

The proportion of students in any given yearly cohort opting to complete their Senior Cycle mathematics studies at Higher Level has more than doubled (15.8% in 2011 to 36.3% in 2024) since the introduction of the BPI and the revised curricula. These figures represent a dramatic change in the numbers and the profile of students engaging in the study of Higher Level mathematics in Ireland and warrants detailed scrutiny. This report examines the perceived impact of the BPI from the perspectives of teachers and students, while also tracking levels of achievement since its introduction.

1.2 Research Aims and Questions

The overall aim of the research reported here is to investigate the practical implications that the increase in proportion of students opting to complete their Senior Cycle mathematics studies at Higher Level has had in the classroom. In addition, the impact the transformation in a typical Higher Level mathematics Senior Cycle cohort has had on assessment outcomes is examined. These aims resulted in the following research questions:

- RQ1: What motivates Senior Cycle students in Ireland to opt to study mathematics at Higher Level?

- RQ2: What are teachers' perceptions of the Bonus Points Initiative in mathematics and its impact on their experiences in the classroom?

- RQ3: Given the significant increase in students opting to complete Senior Cycle mathematics at Higher Level in the period 2011 to 2024, what impact, if any, has this change had on grades awarded in mathematics at this level?

The following sections explore the current state of play of mathematics education in Ireland, particularly at upper secondary level (Section 2), while also examining best practice internationally at this level (Section 3). This is followed by an outline of the research methods and findings of three related studies which focus on students' (Section 4) and teachers' (Section 5) perspectives on bonus points, as well as an analysis of grade achievement in Leaving Certificate Higher Level mathematics from 2008 to 2024 (Section 6). These findings are discussed in detail in light of international best practice, with recommendations for addressing identified issues outlined also (Section 7). Conclusions related to this discussion are presented in Section 8.

2. Mathematics Education in Ireland

2.1 Overview of Mathematics Education in Ireland

Secondary level education in Ireland (often referred to as 'post-primary' level) is subdivided into the Junior Cycle (1st to 3rd Year, typically ages 12-15), an optional Transition Year (4th Year), and Senior Cycle (5th and 6th Year, typically ages 16-18). Mathematics at Senior Cycle is offered at one of three levels: Higher, Ordinary, or Foundation. Higher Level is the most challenging and particular grades at this level are often listed as a pre-requisite for entry into certain Higher Education courses in areas such as medicine, engineering, mathematics, and science. Ordinary Level entails the study of similar concepts but with reduced levels of detail and difficulty. In addition, some topics such as hypothesis testing and integral calculus, which are part of the Higher Level course of study, are not included at Ordinary Level. Foundation Level focuses on basic mathematical skills and is intended for those who struggle with the challenge of Ordinary Level mathematics.

The curriculum at Senior Cycle comprises five strands: Algebra, Number, Functions, Statistics and Probability, Geometry and Trigonometry. Senior Cycle students are assessed wholly by their performance in a state examination encompassing a set of written terminal examinations (the Leaving Certificate examinations) at the end of their final year (6th Year). This has been the case in the previous decades and continues to be the case presently. However, a current and ongoing Senior Cycle mathematics review may result in an altered approach to assessment in the near future with the expected introduction by 2027 of an Additional Assessment Component (AAC) worth a minimum of 40% of the final grade (National Council for Curriculum and Assessment, 2024). The nature of the AAC has yet to be defined.

While mathematics is not strictly compulsory at Senior Cycle, the proportion of Leaving Certificate examination candidates studying mathematics at some level is usually close to full participation, e.g. 98.9% of candidates in 2023 and 98.8% of candidates in 2024 (State Examinations Commission, 2024). This is typically attributed to mathematics being a gatekeeper for the vast majority of Higher Education courses in Ireland, which leads schools to treat mathematics as if it were compulsory. The challenge, therefore, when attempting to improve student participation in mathematics at Senior Cycle is to encourage more students to opt for Higher Level mathematics as virtually all study mathematics at some level.

2.2 Curriculum and Policy Change (2010-2014)

The current Senior Cycle mathematics curriculum was introduced in three phases from 2010 onwards. Parts of this curriculum were gradually added over a three-year period and, simultaneously, parts of the previous curriculum were withdrawn. The first Leaving Certificate examinations linked to this gradually changing curriculum took place in 2012. The first year in which the totality of the new curriculum was fully integrated into the Leaving Certificate examinations was 2014.

Another significant change occurred relating to Senior Cycle mathematics in 2012 with the introduction of 25 'bonus points' for achieving a passing grade (≥40%) in the Higher Level Leaving Certificate mathematics examinations. A passing grade was a D3 or better at the time, a H6 or better in the current grading system. This Bonus Points Initiative (BPI) enables students to achieve a maximum of 125 CAO points in mathematics compared to a maximum of 100 CAO points in any other Senior Cycle subject. A student can achieve a maximum of 625 CAO points in total when combining the points they have attained in up to six subjects in the Leaving Certificate examinations. These points are a significant factor in determining the Higher Education courses in Ireland to which these students have access upon completion of their secondary level education.

Recent research (e.g. O'Meara et al., 2023; Treacy et al., 2020; McCoy et al., 2019) indicates that the introduction of the BPI played a significant role in the increase in the proportion of students opting to complete Senior Cycle mathematics at Higher Level. In the year prior to the BPI coming into effect (2011), this proportion stood at 15.8%; by 2024 this proportion had risen to 36.3% (see Fig. 1). The Department of Education and Skills (2011) set a target of 30% to be reached by 2020 – this goal was achieved by 2017 and subsequently surpassed. Students recognise that even low passing grades in Higher Level Senior Cycle mathematics results in relatively high points awarded. For example, a H6 equates to 71 points (46 plus 25 bonus points, see Table 1) which enables a student to achieve 15 points more than they would for achieving the top grade at Ordinary Level, i.e. 56 points for an O1.

Table 1. Points awarded for grades achieved in Leaving Certificate examinations.

Overall Examination Score	Higher Level Grade	CAO Points	Ordinary Level Grade	CAO Points
≥ 90% to 100%	H1	100	*O1*	*56*
≥ 80% and < 90%	H2	88	*O2*	*46*
≥ 70% and < 80%	H3	77	*O3*	*37*
≥ 60% and < 70%	H4	66	*O4*	*28*
≥ 50% and < 60%	H5	56	*O5*	*20*
≥ 40% and < 50%	H6	46	*O6*	*12*
≥ 30% and < 40%	H7	37	*O7*	*0*
≥ 0% and < 30%	H8	0	*O8*	*0*

Another factor that warrants consideration in this context is the introduction of points awarded for a H7 grade (37 points) which is considered a failing grade. This change came into effect when the grading system was overhauled for the Leaving Certificate examinations from 2017 onwards. Beforehand, students did not receive any points for a failing grade (i.e. achieving less than 40%). McCoy et al. (2019) concluded that this change promoted greater participation in Higher Level study of subjects at Senior Cycle, including mathematics. In any case, the upward trend in proportions opting to study mathematics at Higher Level for Senior Cycle was already evident by 2017 (see Fig. 1), and any subsequent impact of this new measure may be difficult to separate from the impact of BPI.

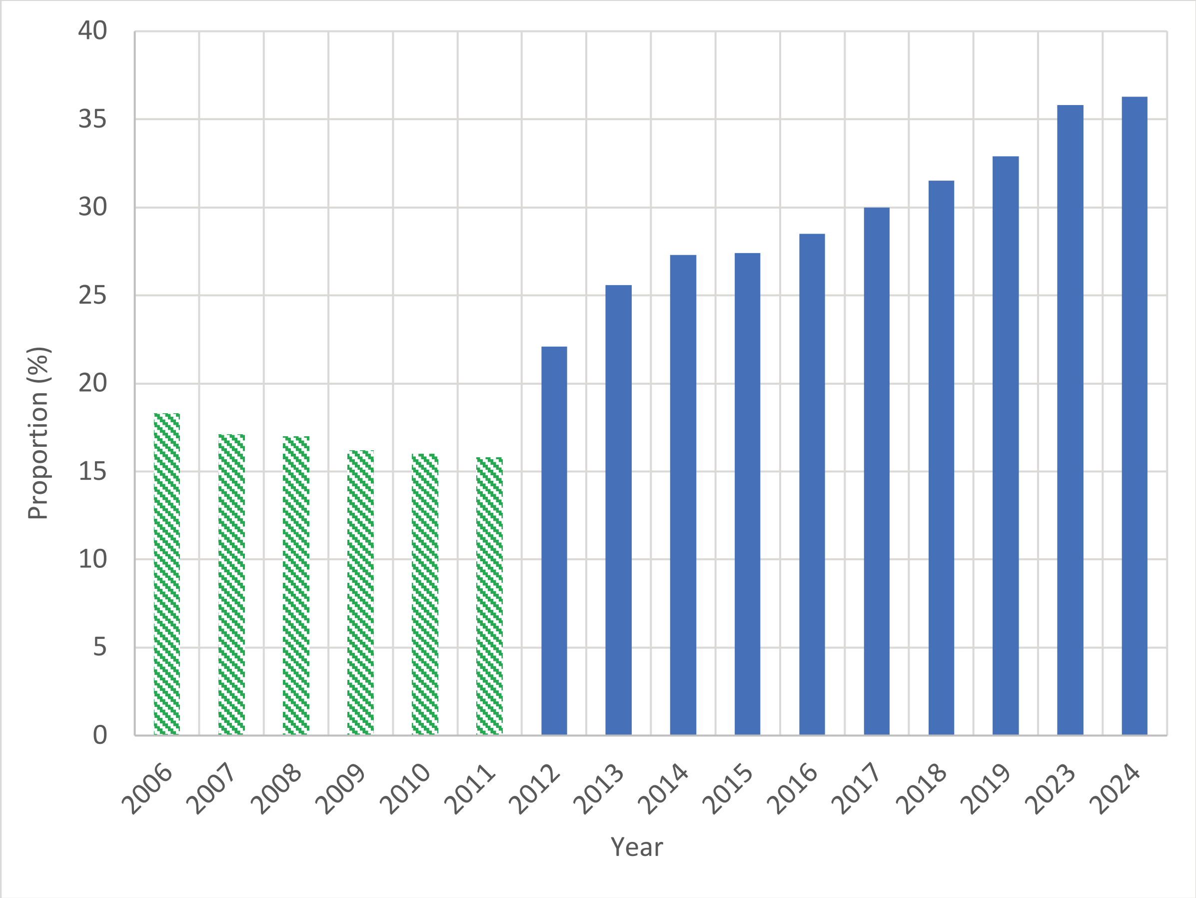

Figure 1. Proportion of students opting to study mathematics at Higher Level for their Leaving Certificate examinations in the years 2006 to 2024. Note: 2020 to 2022 omitted due to the irregular nature of examinations in those years caused by factors related to the COVID-19 pandemic.

2.3 The Leaving Certificate Examinations and Attainment Referencing

This report presents analysis of the grades awarded for Higher Level mathematics in the Leaving Certification examinations and, therefore, it is important to understand the approach used for awarding grades from year to year.

In western nations such as the UK and Ireland, attainment referencing is the common approach applied to 'maintain standards' in high-stakes summative assessments. Newton (2020), in an Ofqual (the Office of Qualifications and Examinations Regulation) report on their application of attainment referencing, indicated that exam boards in the UK strive to ensure that equivalent grades awarded for successive versions of a subject examination can be interpreted in the same way. Newton (2020, p.4) indicated that "exam standards have been maintained when equivalent grade boundary marks across adjacent exams correspond to equivalent levels of attainment".

The State Examination Commission (SEC) in Ireland are responsible for secondary level state examinations in the Irish state. The SEC (2022a, p.25) also adopt attainment referencing as their key principle in maintaining standards from year to year:

> In a normal year, the standard-setting procedures are informed by a combination of expert judgment and statistical information, and follow an underlying model of attainment referencing, which relies for its validity on the *similar cohort adage*. The professional experience of the Chief

> Examiner and the senior examining team with experience of year on year standards arrive at an agreed standard following consideration of a number of factors including the content on the examination paper, the quality of candidate responses to this content and the demands of the marking scheme in the context of previous statistical outcomes.

The SEC (2021, p.2) also indicate that the attainment in each subject with a large number of candidates "will not change radically from one year to the next", although they do indicate that there can be gradual changes over an extended period of time. They claimed that the combination of expert judgement with the statistical comparison of attainment levels of different annual cohorts ensures that standards of achievement are consistently maintained.

Given that grade boundaries are fixed, adjustments are not made to raw scores but to the marking process (State Examinations Commission, 2021). Thus, the marking scheme is adapted to ensure significant fluctuations in grades awarded do not occur. Marking schemes are drafted and re-drafted as they are applied to random samples of candidate work. These sets of marked sample work are reviewed, and results are statistically analysed. Upon completion of this process, the adapted marking scheme is then applied to the work of all candidates. Minor changes to the marking scheme may still be possible beyond this point and would need to be applied to all candidates' work (Baird et al., 2014; State Examinations Commission, 2021).

The aforementioned 'similar cohort adage' is important to note as it presumes that student achievement should not vary significantly from year to year. Therefore, it is the premise for applying adapted marking schemes. Any variations in initial grade distribution tend to be attributed to the relative ease or difficulty of the examination paper(s) in question (Gleeson, 2024).

2.4 Student Performance in International Assessments

To add further context, it is important to consider how students in Ireland perform relative to their international counterparts. In general, secondary level students in Ireland perform well in international assessments of mathematics. The Programme for International Student Assessment (PISA) assesses 15-year-old students across the world every three years in mathematics, science, and reading literacy. Mean scores of students in Ireland on the overall mathematics scale were similar in 2003 (502.8), 2006 (501.5), 2012 (501.5), 2015 (503.7), and 2018 (499.6) (Educational Research Centre, 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 (Educational Research Centre, 2023). Ireland was 11th overall out of 81 participants in mathematics in 2022, performing similarly to the likes of Netherlands, Belgium, Denmark, United Kingdom, and Australia. Ireland outperformed 63 other nations (or economies) including Finland, Sweden, Germany, and France (Educational Research Centre, 2023).

Ireland has also participated in Trends in International Mathematics and Science Study (TIMSS) intermittently over the last 30 years. Pupils in 4th class (primary level, typically age 10) and 2nd year (post-primary level, typically age 14) complete assessments in mathematics and science every four years. Ireland participated in 1995, 2015, 2019, and 2023. The mean mathematics score (522) for 2nd Year pupils in Ireland in 2023 was the highest in the EU, significantly above the scale centre point (500), and seventh overall but was not statistically significantly different to England, Czech Republic, Sweden, and Lithuania (McHugh et al., 2024). Ireland did significantly outperform 34 countries including Finland, Norway, the US, and Australia. Performance of 2nd Year pupils in Ireland in TIMSS mathematics in 2023 was consistent with previous performances in 1995 (519), 2015 (523), and 2019 (524) (McHugh et al., 2024). Results from 2023 also indicate that more pupils are reaching the benchmark for advanced performance in mathematics in 2nd year. However, a gender gap in mathematics for 2nd year pupils is beginning to show with boys (mean score of 528) significantly outperforming girls (514) which was not the case in recent previous iterations of TIMSS (McHugh et al., 2024).

2.5 Student Preparedness for Mathematics at Third Level

Despite strong performances in these international assessments of mathematics, concerns have been raised regarding the mathematical preparedness of students entering Higher Education in Ireland (e.g. Treacy and Faulkner, 2015; Fitzmaurice et al., 2021; Faulkner et al., 2023). Treacy and Faulkner (2015) analysed a database of 10,100 beginning undergraduate students in the University of Limerick which contained mathematics diagnostic test scores, focussing on cohorts in the years 2003 to 2013 inclusive. They noted that the proportion of students at risk of failing their respective university mathematics modules had increased from 30.6% in 2003 to 48.7% in 2013. Similarly, when they controlled for grades achieved in the Leaving Certificate mathematics examinations, performance of the 2013 cohort was statistically significantly below that of the 2003 cohort. Fitzmaurice et al. (2021) noted similar trends when analysing 365 beginning pre-service post-primary mathematics teachers' diagnostic test performance between 1997 and 2013 in the University of Limerick. They indicated that the average performance in this diagnostic test of basic mathematics skills in 1997 was higher than almost all scores achieved by the 2013 cohort.

Faulkner et al. (2023) analysed the basic mathematical skills of 406 Year 1 undergraduate students in an Irish university as well as their ability to apply these skills in problem solving scenarios. These diagnostic tests were completed between 2016 and 2019. They found that every participant performed statistically significantly worse on the problem-solving section when compared to the basic mathematical skills section, indicating that they struggled to apply these basic mathematical skills to solve problems. The authors concluded that the low levels of achievement in problem-solving tasks are a cause for concern, as the development of problem-solving skills was a key aim within the current Senior Cycle mathematics curriculum.

Overall, mathematics in Ireland at post-primary level seems to be in a relatively healthy position as the country consistently performs as well as, if not better than, all other EU countries in international mathematics assessments such as PISA and TIMSS. However, declining levels of mathematical preparedness of beginning undergraduates in Ireland is a worrying development and needs to be kept under review in any discussion of the state of mathematics education in the country.

3. International Best Practice in Enhancing Achievement in Upper Secondary Mathematics

3.1 Policies in the UK, Australia, New Zealand, and USA

A substantial range of nations have placed significant emphasis on enhancing the quality of STEM education (e.g. Department of Education and Skills, 2017; National Science and Technology Council, 2018). Widening and increasing participation in advanced mathematics is a vital component of this drive, as improving achievement in mathematics at secondary level (or high school) has been demonstrated to have a significant impact on persistence and attainment in postsecondary STEM education (Green and Sanderson, 2018). Prior attainment in mathematics is, unsurprisingly, a key predictor of participation and attainment in advanced mathematics at upper secondary level (Brignell et al., 2025; Noyes and Adkins, 2017). This naturally leads stakeholders to explore means for improving mathematics attainment at earlier stages in students' education. For example, the Education Endowment Foundation (2017) in the UK researched best practice for improving the quality of mathematics teaching in Key Stage 2 (age 7-11) and 3 (age 11-14) and disseminated their findings widely. They promoted the application of formative assessment strategies, the teaching of problem-solving strategies, and the building of rich networks of mathematical knowledge amongst pupils, among other recommendations.

Recent research in the UK has focussed on the means by which students who have the potential to progress to studying mathematics at an advanced level (e.g. A-Levels and Higher Education) can be supported to do so. This is referred to as the 'excellence stream' (Brignell et al., 2025). Brignell et al. (2025, p.16) analysed the mathematics education 'pipeline' in England and concluded that there is "no magic bullet that can resolve the challenge of increasing engagement, outcomes and participation in mathematics to 18 and beyond." Instead, targeting improvements in particular areas of mathematics education are encouraged. Such improvements include interventions for students aged 11-14 years to include specialist teacher programmes to enhance learning at this age range; enhanced provision of mathematics clubs and competitions; and the development of virtual maths schools which would allow for greater outreach and engagement programmes (Noyes et al., 2023). Additionally, there are recommendations to promote career pathways which require mathematics knowledge and skills, while also highlighting the value of mathematics in a range of professions. Promotion of mathematics role models, particularly for groups underrepresented in advanced mathematics study, is also suggested (Noyes et al., 2023).

In Australia, participation in advanced mathematics has been in decline which seems to be attributable, at least in part, to the removal of mathematics as a pre-requisite for many university degree programmes (Jennings, 2022; Hine et al., 2024). Recommendations to address these low participation rates included a review of that decision on pre-requisites and a renewed focus on encouraging more females to choose advanced mathematics (Jennings, 2022; Hine et al., 2024). Establishing mathematics as a pre-requisite for entry into Higher Education has been consistently shown to be an important factor in participation in upper-secondary mathematics across various regions (Hodgen et al., 2013). Interestingly, Queensland in Australia has a bonus points scheme for studying advanced mathematics for two years up to the end of Year 12. Students who achieve a final passing grade are awarded two bonus points to boost their university entrance score. This appears to have had a positive effect on participation rates in Higher Level mathematics in this region when compared to other regions in the country that have not implemented such a measure (Jennings, 2022).

However, the impact does not seem to be as pronounced as it is in Ireland, probably owing to the fact that the bonus points awarded are proportionally much lower than the BPI in Ireland.

New Zealand has been highlighted in the past as a nation that have had relative success in enhancing participation in advanced mathematics at upper secondary level. Hodgen et al. (2013) indicated that this success is attributable, at least in part, to the provision of a range of pathways in advanced mathematics which enable students to structure their studies to suit their needs. Students can select from two areas – mathematics with calculus and mathematics with statistics. Students may select options from each area, thus opening up a range of pathways (Hodgen et al., 2013).

Other nations tend to broaden examination of these challenges in mathematics to include consideration of all STEM subjects. In 2018, the United States of America set three overarching goals for their five-year STEM education strategic plan. These included: ensuring all learners develop mastery of basic STEM concepts; access to high quality STEM education for all, particularly underrepresented groups; and the creation of authentic learning experiences to better prepare learners to pursue STEM careers (National Science and Technology Council, 2018).

3.2 Addressing Mathematics Anxiety

Addressing issues such as the prevalence of 'mathematics anxiety' is also posited as a means for enhancing participation in mathematics. Mathematics anxiety presents in learners as an increase in "fear, tension, and apprehension" when a person engages in mathematics (Zhang et al., 2019, p.1). A meta-analysis of 73 studies on mathematics anxiety concluded that there was a moderate negative correlation $(r = -0.42)$ between students' motivation to learn mathematics and mathematics anxiety (Li et al., 2021). A meta-analysis of 49 studies across different regions which incorporated different measures of mathematics anxiety indicated that there is also a robust link between mathematics anxiety and performance in mathematics (Zhang et al., 2019).

Motivation and prior attainment are key indicators for participation in advanced mathematics at secondary level, which suggests that mathematics anxiety is a significant issue. Interventions are recommended, particularly early in a child's education, to reduce mathematics anxiety in order to remove barriers for students and, thus, enable greater participation and achievement in mathematics (Dowker et al., 2016). Achieving success when learning mathematics is an important means for combatting mathematics anxiety. One potential means of enabling such experiences is to break down the learning process into small goals to signpost achievements as they progress in their learning (Li et al., 2021). Verbal encouragement and positive messages regarding the learning of mathematics from parents and teachers is also important to enable positive attitudes towards the subject.

Overall, the means by which education systems strive to increase and widen participation in advanced mathematics at secondary level are varied. However, it is interesting to note that approaches similar to the BPI are quite rare. Therefore, the experiences of students and teachers in Ireland over the past 15 years provide a valuable case study in measures of this nature. The following chapter examines the student perspective, particularly in relation to their motivations to opt for Higher Level mathematics at Senior Cycle.

4. Student Motivation to Study Senior Cycle Mathematics at Higher Level

This section will focus on a study designed and implemented to gain an in-depth understanding of students' motivations for studying mathematics at Higher Level for Senior Cycle. This will aid in answering Research Question 1:

RQ1: What motivates Senior Cycle students in Ireland to opt to study mathematics at Higher Level?

4.1 Research Design

In order to gain insights into students' reasons for pursuing Higher or Ordinary Level mathematics at Senior Cycle, there was a clear need for a large and diverse sample. As such, surveys were deemed to be the most effective tool to achieve this and, thus, the authors employed survey research design. In addition to enabling a large and diverse sample, surveys also ensure anonymity, which encourages greater levels of honesty leading to more reliable data (Cohen, Manion, and Morrison, 2017). A modified version of a survey which had been designed and validated for use in Queensland, Australia to investigate the reasons behind students' decision to pursue advanced mathematics in that state was utilised. Slight modifications of this survey were required in order to reflect the Irish context, but these modifications were not significant enough to detract from its validity. Rather, these modifications enabled examination of the local issues pertaining to the BPI and the CAO points system in the research instrument.

The population for this study consisted of all Senior Cycle students (5^{th} or 6^{th} year) in Ireland. In total, two surveys were used; one designed for those students who opted for Higher Level mathematics and a second for students who chose to pursue Ordinary Level mathematics at Senior Cycle. Both surveys were identical in structure with the only difference across the two being in relation to the wording and phrasing of questions. In total, there were 27 items included in both surveys. Section A, which was identical across both surveys, contained 4 items which collected information in relation to participant's demographics (gender, current year of study, Junior Certificate examination level and grade).

The opening part of Section B on both surveys yielded quantitative data. Participants were provided with nineteen potential reasons, identified in the literature, for opting to study Higher or Ordinary Level mathematics and asked to state, on a five-point Likert scale (from strongly agree to strongly disagree) if each of the reasons played a significant role in their decision to study mathematics at that particular level. The statements on each survey were similar but, for example, if the reason given on the Higher Level survey was *I find mathematics interesting,* the corresponding reason on the Ordinary Level survey was *I don't find mathematics interesting.* The latter part of Section B in both surveys yielded qualitative data. First, participants in both surveys were asked to outline any other reasons, not given in the list of nineteen, that influenced their decision and secondly to identify the reason, from all those listed, that was most influential in their decision to undertake their chosen level of mathematics. They were also asked to outline at what stage in secondary school they made the decision to pursue mathematics at this level and how they reached this decision.

4.2 Sample

Ethical approval for this study was secured from the Faculty of Education and Health Sciences Research Ethics Committee in the University of Limerick in September 2019. Following this, participants were recruited through convenience sampling as the researchers contacted school administrators with whom they had previously worked. In total, the authors sought to survey 2000 secondary level students and, in order to achieve this number, 12 schools were originally selected. Five vocational schools[1] and seven secondary schools were invited to participate, aligned with the national school type breakdown. Of the 12 schools selected, 2 withdrew from the study in the early stages and so the final sample was made up of 10 schools. Upon obtaining permission from the responsible authority at each of these 10 schools, the researchers provided consent forms to students (and their parents) who met the criteria (Senior Cycle students studying mathematics at Higher or Ordinary Level) and, between October and December 2019, questionnaires were distributed to all students who had given consent to participate. This approach resulted in a sample of 1702 Senior Cycle students participating in the study. Of these, 911 were studying Higher Level mathematics while the remaining 791 were engaging with the Ordinary Level course. Further information about the sample for this study is provided in Table 2 below. Due to the focus of this report, henceforth we will only report on the data collected from the 911 students who were pursuing Higher Level mathematics.

Table 2. Sample Demographics

	Higher Level		***Ordinary Level***		***Total***
	5th Year	**6th Year**	**5th Year**	**6th Year**	
Male	236	204	187	159	786
Female	254	208	208	213	883
Prefer not to say	5	4	14	9	32
Missing	0	0	0	1	1
Total	495	416	409	382	1702

4.3 Data Analysis

As described previously, the survey utilised for this study yielded both quantitative and qualitative data. The quantitative data was recorded and transferred to an SPSS (Version 22) file for analysis. Once in SPSS, the authors generated descriptive statistics and conducted Mann Whitney U tests to determine whether differences in responses recorded across mutually exclusive groups were statistically significant. The qualitative data collected as part of this study was recorded and transferred to NVivo (Version 11). In order to analyse this data, the authors followed Braun and Clarke's (2006) six-step approach to thematic analysis. This approach involved the following steps for the authors:

1. Familiarising themselves with the data;
2. Generating initial codes;
3. Searching for themes;

[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.

4. Reviewing potential themes;
5. Defining and naming themes;
6. Producing findings.

Two authors initially coded the data independently. Once this was complete the authors came together to discuss the themes each had generated. Differences in the themes generated were discussed until a final set of themes was agreed upon. This involved the amalgamation of some themes and the rewording of others to reflect the data more accurately. This process allowed for the systematic examination and interpretation of the reasons, other than the 19 offered, given by students for undertaking Higher Level mathematics and allowed the researchers to discover a series of patterns and themes in this regard.

4.4 Findings: Students' Perspective

In order to ascertain students' reasons for pursuing Higher Level mathematics, they were first asked to state on a five-point Likert scale (from strongly agree to strongly disagree) which of the 19 given reasons played a significant role in their decision to study mathematics at Higher Level. Figure 2 summarises students' responses to this question.

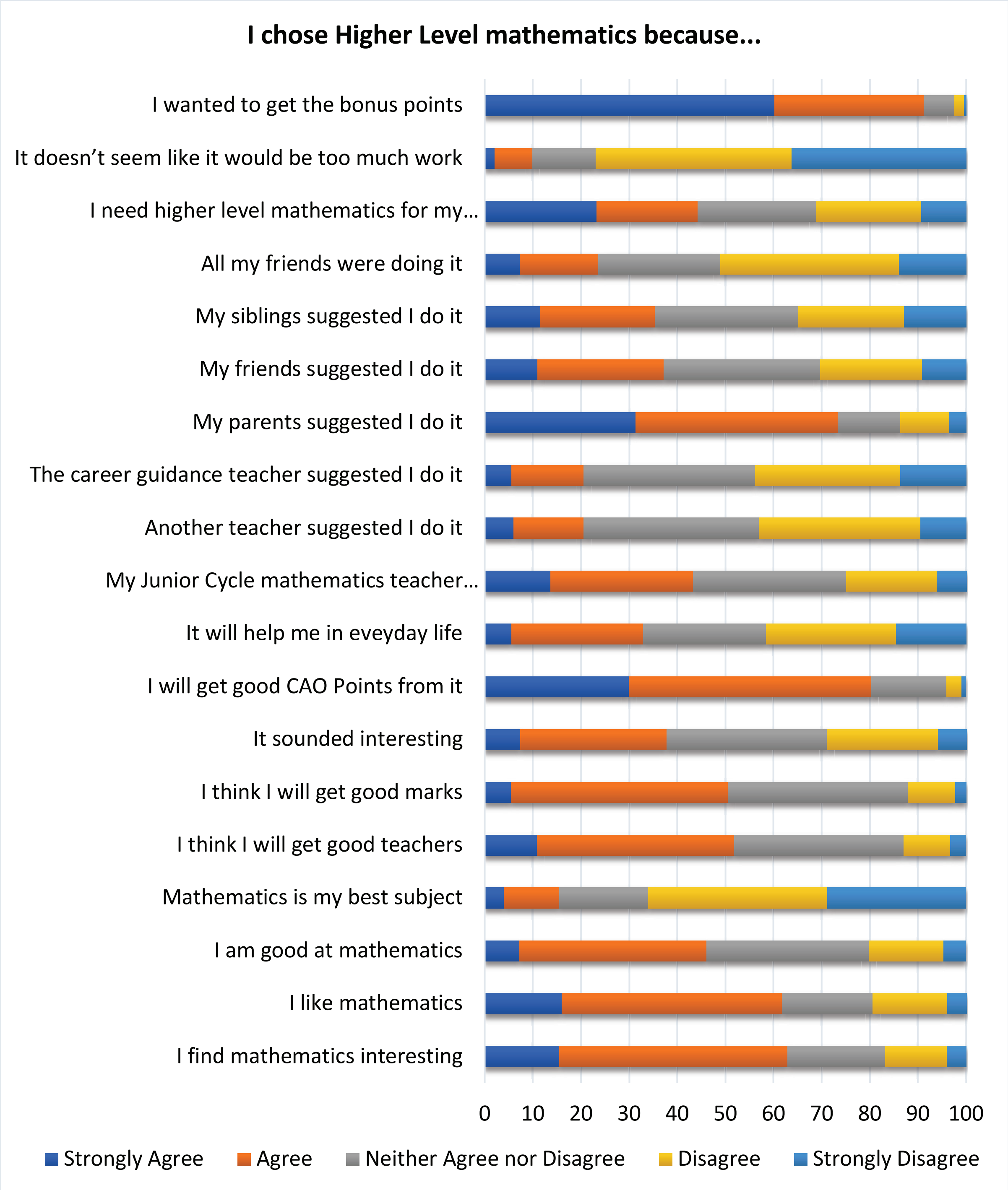

Figure 2. Students' (n = 911) level of agreement with the different reasons for studying Higher Level mathematics

Figure 2 shows that, in the main, students in Ireland are extrinsically motivated to study Higher Level mathematics. By far the greatest proportion of students (60.2%, n = 548) strongly agreed that the BPI was an influential factor in their decision to pursue Higher Level mathematics. A further 31.0% (n = 282) agreed that this was a motivating factor while only 2.5% disagreed or strongly disagreed that the BPI was influential in their decision. The next three reasons that students strongly agreed played a role in their decision to pursue Higher Level mathematics were *My parents suggested I do it* (31.4%, n = 285); *I will get good CAO points* (30.0%, n = 273) and *I need Higher Level mathematics for my university course* (23.3%, n = 210). This analysis shows that the points on offer for mathematics and the entry requirements for many courses at third level are the driving force behind students' decision to pursue Higher Level mathematics while parents are the most influential third party in this decision.

On the other hand, the three reasons that students reported as being least likely to influence their decision to pursue Higher Level mathematics were: (1) *It doesn't seem like it would be too much work* (36.2%, n = 330 strongly disagreed); (2) *Mathematics is my best subject* (28.7%, n = *261*); and (3) *It will help me in everyday life* (14.5%, n = 132). This suggests that the accessibility of the course; students' self-belief in their mathematical ability; and the perceived utility value of mathematics were the least influential factors in students' decision to pursue Higher Level mathematics. Therefore, it is evident that students in Ireland are typically not intrinsically motivated to pursue mathematics in its most advanced form.

The impact of the BPI on students' decision to pursue Higher Level mathematics was further emphasised when students indicated which of the nineteen factors listed was most influential in their decision. 893 of the 911 students within this sample offered a response to this question and the five most popular responses are provided in Figure 3.

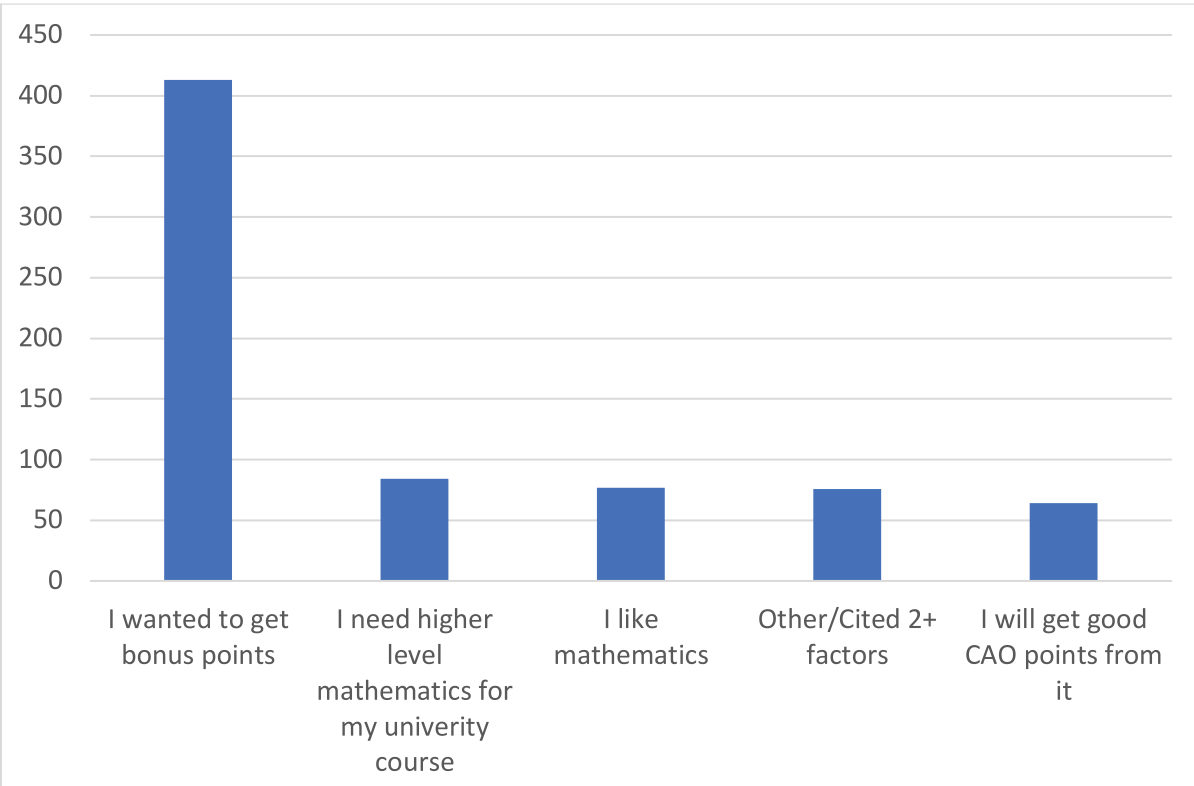

Figure 3. Students' top 5 most influential factors for the uptake of mathematics

By far the most popular response to this question was the desire to obtain bonus points, with close to half of the students (46.2%, n = 413) citing this as the most influential factor. A further 16.2% of students cited one of the other "points related" reasons as the most influential factor underpinning their decision, while 8.3% of students cited either a different reason to those listed or cited more than one reason. Students who fell into this category were asked to elaborate and analysis of this qualitative data showed that of the 76 students in this category, 58 offered more than one factor, and

93.1% (n = 54) of these responses included a reference to bonus points (n = 35) and CAO points (n = 19). Hence, in total 68.4% of the 893 students who responded to this question felt that the points system in place in Ireland was the most influential factor in their decision to pursue Higher Level mathematics. On a more positive note, the third most popular response to this question suggested that some students were primarily intrinsically motivated to pursue Higher Level mathematics. 8.6% of students reported that liking mathematics was the primary reason that they pursued Higher Level mathematics. However, other factors which suggest that students were primarily intrinsically motivated were not deemed to be influential. For example, only 4.4% of respondents stated that they chose Higher Level mathematics primarily because they found it interesting; 5.9% stated that they chose Higher Level because they are good at mathematics, while 0.7% of respondents said they opted for Higher Level as it would be of benefit to them in the tasks that they are required to carry out on a daily basis and 0.1% said they studied mathematics primarily because they were interested in the subject. Hence, while it was encouraging to see the reason *I am good at maths* feature in the top 5 most influential factors, further analysis shows that when all intrinsic motivating factors (five in total) were considered only 19.7% of the sample deemed **any** of these factors to be the most influential in their decision compared to 62.4% who cited one of the three factors relating directly to the points system in place.

Once the primary motivating factors were established, the authors sought to determine if the reasons for studying Higher Level mathematics differed across:

1. Gender;
2. School type;
3. Prior attainment.

In order to conduct this analysis, the dataset was split into mutually exclusive groups:

1. male vs. female;
2. vocational schools vs. secondary schools;
3. obtained a mark of 70% or greater in the Junior Cycle exam vs. obtained a mark less than 70% in the Junior Cycle exam.

Next, the mean score for each of these groups was determined. In the survey, a score of one indicated that the student strongly agreed that the reason was influential in their decision to pursue Higher Level mathematics while a score of five indicated that they strongly disagreed. Therefore, a lower mean score for any given statement indicated greater levels of agreement with that statement while a higher mean score indicated lower levels of agreement, thus suggesting that factor was less influential in their decision to study Higher Level mathematics. The mean score for male and female students and the p-value for significance are presented in Table 3.

Table 3. Differences in responses across gender

Item	*Male*	*Female*	*Sig.*
	Mean (s.d.)	**Mean (s.d.)**	***p***
I find maths interesting	2.39 (1.01)	2.46 (1.03)	0.247
I like maths	2.45 (1.03)	2.47 (1.08)	0.791
I am good at maths	**2.57 (0.93)**	**2.86 (0.98)**	**<0.001***
Maths is my best subject	**3.67 (1.12)**	**3.90 (1.74)**	**0.016***
I think I will get good teachers	**2.43 (0.89)**	**2.63 (0.94)**	**0.001***
I think I will get good marks	**2.43 (0.76)**	**2.73 (0.89)**	**<0.001***
It sounded interesting	2.83 (1.00)	2.95 (1.04)	0.110
I will get good CAO points	1.89 (0.79)	2.00 (0.83)	0.051
It will help me in everyday life	3.19 (1.21)	3.17 (1.09)	0.800
My Junior Cycle maths teacher suggested I do it	2.72 (1.07)	2.75 (1.13)	0.701
Another teacher suggested I do it	**3.21 (0.97)**	**3.31 (1.06)**	**0.046***
The career guidance teacher suggested I do it	**3.24 (1.06)**	**3.39 (1.06)**	**0.013***
My parents suggested I do it	2.09 (1.03)	2.16 (1.12)	0.705
My friends suggested I do it	2.94 (1.09)	2.89 (1.17)	0.460
My siblings suggested I do it	3.03 (1.12)	2.99 (1.26)	0.783
All my friends were doing it	**3.21 (1.10)**	**3.45 (1.14)**	**<0.001***
I need Higher Level maths for my university course	**2.50 (1.27)**	**2.94 (1.27)**	**<0.001***
It doesn't seem like it would be too much work	**3.19 (1.09)**	**4.11 (0.89)**	**0.023***
I wanted to get the bonus points	1.47 (0.66)	1.55 (0.80)	0.456

Table 3 shows that significant differences in the levels of agreement offered by males and females were recorded in nine of the nineteen statements (highlighted in **bold**). Some of the most notable differences were recorded for the statements *I need Higher Level mathematics for my university course* and *I think I will get good marks*. The average male score for *I need Higher Level mathematics for my university course* was 2.50 (SD = 1.27) while the median score among this cohort was 2. The corresponding mean among female students was 2.94 (SD = 1.27) while the median was 3. This shows that males were more likely to agree with this statement. As the data for this response was not normally distributed and the data was ordinal, a Mann Whitney U test was carried out to determine if the differences recorded were statistically significant. This test showed that the male score was significantly lower than the female score ($U = 80627$, $p < 0.001$).

For the second statement, *I think I will get good marks*, the mean score for males was 2.42 (SD = 0.76; median = 2) while the mean score among females was 2.73 (SD = 0.86; median = 3). In this instance, the responses were normally distributed but because the dependent variable was ordinal, a t-test was deemed inappropriate and so a Mann Whitney U test was again conducted to check if the differences noted in Table 3 were statistically significant. This test showed that again the differences recorded were statistically significant ($U = 80860.5$, $p < 0.001$). This indicates that males were more likely to agree with this statement than their female counterparts, indicating greater levels of belief in their own ability to excel in Higher Level mathematics among males.

Another finding to emerge when results were compared across gender was that for all the reasons relating to self-efficacy (e.g., *I study Higher Level mathematics because I am good at mathematics* or *I study Higher Level mathematics because mathematics is my best subject*), males recorded a significantly lower mean score than females. This is despite the fact that female students actually achieved slightly better grades in their Junior Cycle exam. For example, 62.4% of females in the sample achieved a mark of 70% or greater in their Junior Cycle mathematics examination compared to 61.9% of males reaching this threshold. While this difference in performance is not significant, it is interesting to note that even though females performed equally as well, and in some cases better, than their male counterparts in prior state examinations, males demonstrated higher self-belief in relation to their mathematical performance and this played a role in their choice to pursue Higher Level mathematics.

The second comparison conducted by the authors sought to determine if the type of school a student attended had an impact on the reasons cited for choosing Higher Level mathematics. Table 4 presents the mean scores and associated *p*-values for students from vocational and secondary schools.

Table 4. Differences in responses across school type

Item	*Secondary* Mean (SD)	*Vocational* Mean (SD)	*Sig.* *p*
I find maths interesting	2.47 (1.06)	2.35 (0.95)	0.192
I like maths	2.47 (1.07)	2.44 (1.05)	0.694
I am good at maths	2.73 (0.99)	2.68 (0.92)	0.663
Maths is my best subject	3.83 (1.66)	3.72 (1.11)	0.428
I think I will get good teachers	2.55 (0.95)	2.51 (0.88)	0.727
I think I will get good marks	2.63 (0.86)	2.51 (0.76)	0.089
It sounded interesting	2.90 (1.05)	2.89 (0.99)	0.986
I will get good CAO points	**1.99 (0.82)**	**1.87 (0.78)**	**0.045***
It will help me in everyday life	3.16 (1.16)	3.20 (1.13)	0.588
My Junior Cycle maths teacher suggested I do it	**2.63 (1.10)**	**2.92 (1.08)**	**<0.001***
Another teacher suggested I do it	3.26 (1.03)	3.26 (1.00)	0.893
The career guidance teacher suggested I do it	3.30 (1.09)	3.33 (1.02)	0.819
My parents suggested I do it	2.07 (1.06)	2.21 (1.09)	0.055
My friends suggested I do it	2.87 (1.15)	2.97 (1.09)	0.165
My siblings suggested I do it	2.99 (1.22)	3.03 (1.17)	0.562
All my friends were doing it	3.35 (1.13)	3.31 (1.12)	0.486
I need Higher Level maths for my university course	2.71 (1.28)	2.75 (1.30)	0.726
It doesn't seem like it would be too much work	4.04 (0.97)	3.96 (1.04)	0.375
I wanted to get the bonus points	1.50 (0.72)	1.53 (0.77)	0.485

In this instance, significant differences were noted in two of the statements. Firstly, the CAO points system appears to be more influential for vocational school students compared to secondary school students. The mean score for the statement *I will get good CAO points from it* for vocational school students was 1.87 (SD = 0.78) compared to a mean of 1.99 (SD = 0.82) for secondary school students. Using a Mann Whitney U test, this difference was found to be significant (U = 90273.5, p = 0.045). Such findings indicate that the points system is considered a greater driving factor for vocational school students compared to their peers attending a secondary school. The second statement in which a significant difference was noted across these two groups was *My Junior Cycle mathematics teacher suggested I do it* with students who attended secondary schools more likely to cite their mathematics teacher as having an influence on their decision to study Higher Level mathematics. The average secondary school student score for this statement was 2.63 (SD = 1.10) while the median score among this cohort was 3. The corresponding mean among students attending a vocational school was 2.92 (SD = 1.08) while the median was also 3. A Mann Whitney U test was again deemed appropriate to determine if the differences recorded were statistically significant. This test showed that the scores for those attending secondary schools were significantly lower than the scores for those attending vocational schools ($U = 82750.5$, $p < 0.001$).

The third and final comparison conducted by the authors sought to determine if the influential factors differed depending on students' prior attainment. In order to conduct this analysis, the authors drew on data collected in Section A of the survey in relation to the grade students achieved at Junior Cycle. In total, 893 students provided information on the grade they obtained at Junior Cycle. Using this data, the authors were able to split the data set into two groups. Group 1 consisted of students who obtained a score of 70% or greater in their Junior Cycle Higher Level examination ($n = 557$), while group 2 was made up of all students who obtained a score of less than 70% in this examination or who sat the Ordinary Level paper at Junior Cycle ($n = 336$). The results of this analysis are presented in Table 5.

Table 5. Differences in responses across prior attainment

Item	*>70%*	*<70%*	*Sig.*
	Mean (SD)	**Mean (SD)**	***p***
I find maths interesting	**2.21 (0.97)**	**2.77 (1.03)**	**<0.001***
I like maths	**2.19 (0.99)**	**2.89 (1.05)**	**<0.001***
I am good at maths	**2.40 (0.89)**	**3.25 (0.87)**	**<0.001***
Maths is my best subject	**3.53 (1.70)**	**4.22 (0.85)**	**<0.001***
I think I will get good teachers	2.56 (0.94)	2.49 (0.90)	0.331
I think I will get good marks	**2.40 (0.79)**	**2.88 (0.80)**	**<0.001***
It sounded interesting	**2.79 (1.04)**	**3.09 (0.98)**	**<0.001***
I will get good CAO points	**1.79 (0.74)**	**2.19 (0.86)**	**<0.001***
It will help me in everyday life	**3.10 (1.11)**	**3.31 (1.19)**	**0.008***
My Junior Cycle maths teacher suggested I do it	**2.60 (1.10)**	**2.97 (1.05)**	**<0.001***
Another teacher suggested I do it	3.21 (1.03)	3.35 (0.98)	0.086
The career guidance teacher suggested I do it	**3.24 (1.09)**	**3.42 (1.03)**	**0.024***
My parents suggested I do it	**2.09 (1.10)**	**2.19 (1.03)**	**0.039***
My friends suggested I do it	2.90 (1.17)	2.93 (1.06)	0.996
My siblings suggested I do it	3.00 (1.22)	3.01 (1.18)	0.969
All my friends were doing it	3.33 (1.14)	3.38 (1.10)	0.726
I need Higher Level maths for my university course	**2.61 (1.31)**	**2.94 (1.23)**	**<0.001***
It doesn't seem like it would be too much work	4.04 (0.97)	3.96 (1.04)	0.375
I wanted to get the bonus points	1.50 (0.72)	1.53 (0.77)	0.485

As shown in Table 5, statistically significant differences in mean scores were recorded for fourteen of the eighteen statements. The mean scores of students in Group 1, that is those students who achieved a score of 70% or higher in their Junior Certificate, were significantly lower for the three reasons associated with self-efficacy towards mathematics (*I am good at mathematics, Mathematics is my best subject* and *I think I will get good marks*) thus indicating that these reasons resonated more so with them than students who achieved less than 70% or sat the Ordinary Level paper at Junior Cycle. Similar findings emerged when reasons relating to positive dispositions towards mathematics were considered. For the statement *I like mathematics* the mean score for Group 1 students was 2.19 (SD = 0.99) compared with a mean of 2.89 (SD = 1.05) for lower achieving students. This difference was found to be statistically significant ($U = 65030.5$, $p < 0.001$). Similar results were noted for the statement *I find mathematics interesting* and *I like mathematics*. On the other hand, the only reason that students who obtained less than 70% in the Junior Certificate (Group 2) were more in agreement with was *I wanted to get the bonus points*. Their mean score for this statement was 1.48 (SD = 0.75) compared with a mean of 1.56 (SD = 0.73) for those who achieved 70% or greater.

These findings combined indicate that those who excelled in Junior Cycle mathematics were more intrinsically motivated to undertake Higher Level mathematics at Senior Cycle, whereas extrinsic motivation was more prevalent among those who achieved less than 70% in their Junior Certificate mathematics examinations.

5. Teachers' Perceptions of Bonus Points in Senior Cycle Mathematics

This section provides insights into teachers' perspective on the BPI and plays a significant role in responding to Research Question 2:

RQ2: What are teachers' perceptions of the Bonus Points Initiative in mathematics and its impact on their experiences in the classroom?

5.1 Research Design

The authors designed and disseminated a teacher questionnaire in order to address Research Question 2. The aim of this questionnaire was to gather data on teachers' overarching perceptions of the BPI, its impact on the student profile in Higher Level mathematics classes, its impact on their teaching of Senior Cycle mathematics, and their perspectives on the initiative's future. The authors developed the questionnaire with the assistance of a research advisory group involving five experienced post-primary mathematics teachers. The finalised instrument comprised of four main sections. Section 1 sought basic demographic information. Section 2 and 3 sought teachers' views on how they felt the BPI had impacted the student profile in their class and as a result, their teaching approaches. Section 4 inquired about teachers' overarching perceptions of the BPI, specifically enquiring as to the perceived advantages and disadvantages of the BPI, along with their perspectives on its future.

5.2 Sample

The sampling frame for the study was a list of all 723 post-primary schools in Ireland. Having consulted with the teacher advisory group, it was established that on average there are two Senior Cycle Higher Level mathematics teachers in each school in Ireland. Hence using this estimate, a stratified random sample of 400 post-primary schools around Ireland was selected. This sampling technique ensured that an accurate representation of each type of school (secondary (51%), vocational (36%), community (11%) and comprehensive (2%)) was included in the sample. The questionnaires were distributed (two to each of the 400 post-primary schools) in early April 2018. They were sent to the Head of Mathematics in each of the 400 schools and they were asked to distribute them to Senior Cycle Higher Level mathematics teachers. The packs sent to the schools included information sheets for all involved, the questionnaires, and stamped addressed envelopes for completed questionnaire returns. The information sheets issued to the Department Heads invited the recipients to make copies of the questionnaires for additional Higher Level teachers in their schools, if necessary. Each stamped addressed envelope was also given a number corresponding to the particular school so the researchers could identify the schools that had not returned the completed questionnaires. Two weeks after sending the questionnaires, follow-up telephone calls to each of these schools were undertaken to increase the response rate. The response rate was 266 Senior Cycle Higher Level mathematics teachers (approx. 33%) across 173 post-primary schools.

5.3 Data Analysis

The quantitative data gathered via the questionnaire were recorded, summarised, and analysed using the computer package SPSS (Version 22). The data from the open-ended questions were transcribed into a Microsoft Word document and, similar to the student data, the authors employed thematic content analysis. A coding scheme was generated based on a mixed deductive and inductive approach. On the one hand, codes were derived theoretically, taking into account the research question, the literature review, and the results emanating from the quantitative analysis. On the other hand, themes were identified from the open-ended questions, providing the basis for generating new codes or modifying the existing codes. The coding allocated by each researcher was then compared and any discrepancies were discussed and resolved by the authors in order to provide sound and consistent interpretation of the data before the coding framework was finalised. Once a set of fully worked-out themes was established, the coding frameworks were summarised in some instances using a frequency/percentage analysis and supported by direct quotations from participants' responses where relevant. Some of these coding frameworks are illustrated in a series of tables in the Findings section. In each of these, ƒ refers to the number of teachers who mentioned a particular theme. Themes repeated by the same teacher (T) were not counted twice. However, participants sometimes mentioned more than one theme, explaining why ƒ often exceeds the total number of teachers who responded to the particular question (*n*).

5.4 Findings: Teachers' Perspective

5.4.1 Teachers' overarching perceptions of the BPI

Teachers were asked, through two multiple-choice questions, whether they agreed with the BPI (n = 266) and whether the BPI had raised the standard of mathematics in their school (n = 265). While 46% of respondents indicated that they agreed with the BPI, 27% did not, and a further 27% signalled that they were unsure. In relation to whether the BPI had raised the standard of mathematics in their school, the majority (59%) of respondents felt that the incentive had not resulted in an improvement. While 19% felt that it had, a considerable proportion (23%) indicated that they were unsure. A cross tabulation was employed to determine the relationship, if any, between the responses to both of these initial questions (see Table 6).

Table 6. Teachers' level of agreement with BPI and whether it has raised the standard of mathematics

	BPI has raised the standard of mathematics	*BPI has not raised the standard of mathematics*	*Unsure whether BPI has raised the standard*	***Total***
Agree with BPI	41	52	28	**121**
Disagree with BPI	3	63	6	**72**
Unsure whether I agree or disagree	6	40	26	**72**
Total	**50**	**155**	**60**	**265**

Unsurprisingly, as evidenced in Table 6, the vast majority of those who did not agree with the BPI, felt that it had not raised the standard of mathematics in their school (*n* = 63; 87.5%). Also, it was not surprising to find that very few of those who disagreed or who were unsure about the BPI, agreed that it had raised the standard (*n* = 3; 4.2% and *n* = 6; 8.3% respectively). The data is a little more inconclusive for those who agreed with the BPI: 43% (*n* = 52) of those who agreed with the initiative felt that it had not raised the standard of mathematics in their school and a further 23% (*n* = 28) were unsure. This may indicate that there are other reasons as to why these teachers agree with the BPI. Further information around such reasons was sought in two subsequent open-ended questions in which teachers were asked for their opinions regarding the main advantages and disadvantages of the BPI. The main themes, which were generated from the responses to these questions, are outlined in Tables 7 and 8.

Table 7. Advantages of the BPI (n = 252; f = 298).

Theme	***Total f*(%)***	***Sample Responses***
Increases number of students opting for and continuing LC HL maths	104 (34.9%)	T216: A few strong students do Higher Level that may have strategically dropped it. T112: It definitely made more students stay in 'H' level who should have stayed where previously they would just have opted out to concentrate on other subjects.
** Increases number of girls opting for LC HL maths*	4 (1.3%)	T265: Greater uptake of HL amongst female students.
Rewards students for the time and effort required for LC HL	68 (22.8%)	T20: Recognises that honours [Higher Level] maths require more time/attention for students than some other subjects at Higher Level. T195: Reflective of the extra effort + time needed for the candidates.
No advantages	29 (9.7%)	T2: I don't see any advantages. T88: I get that it is trying to promote HL maths but to me I don't really see any advantages.
Motivates students to work harder at maths	27 (9.1%)	T93: It is encouraging students to push themselves at maths. T222: Students are likely to work harder knowing there is a greater reward.
Raises profile and recognises importance of subject	25 (8.4%)	T63: Highlights the importance of maths in the curriculum. T68: Recognition of the subject's importance.
Extra points and increases access to courses	25 (8.4%)	T3: The only advantage in my opinion is the obvious one – 25 bonus points. T148: Students are given a broader range of courses in college with 25 extra points.
Increases uptake of JC HL maths	12 (4%)	T50: It has encouraged an uptake of HL maths at JC level.
Exposes students to a higher standard of maths	8 (2.7%)	T146: More mainstream students are being exposed to a higher standard of mathematics.

*Sub-theme – The four statements in this sub theme are double coded and are also counted as part of the main theme

Table 8. Disadvantages of the BPI (n = 250; f = 372)

Theme	*Total f (%)*	*Sample Responses*
Encourages students who are not up to the standard to stay at LC HL maths or drop to OL very late	131 (35.2%)	T103: Students who are not capable of doing H.L are now doing it and sticking with it, even though they FAIL every class assessment from start of 5th year! T163: Students continue with HL maths in 6th year for longer than previously before dropping to OL.
Puts the focus of maths on LC points rather than on knowledge, understanding and enjoyment of subject	57 (15.3%)	T2: Maths is reduced to a vehicle for points… it is merely currency in the CAO marketplace. T18: Too many students are gambling with the system instead of making a well-reasoned decision because of their ability.
Slows down the pace of HL class & holds back more able students	50 (13.4%)	T4: Well able students been "held back" not getting attention/pace they need. T46: Students of a stronger mathematics ability may not be extended to the same degree.
Increases levels of pressure, stress and anxiety on struggling students	42 (11.3%)	T12: Students who should be placed at OL – undergoing mental torture to try and complete the HL course. T13: Students who would be happy, strong OL students are overwhelmed and stressed at HL.
Increases pressure on teachers	16 (4.3%)	T62: Pressure on teacher to bring OL students through the HL course successfully. T244: Added pressure on teachers due to a greater spread of ability in the class.
Increases parental demand and expectations on students to study HL	16 (4.3%)	T16: Parents put pressure on students to do HL where they are often not able to. T67: Pressure from parents being placed on students to achieve a level they are not capable of.
Increases risk of students failing LC maths	13 (4.8%)	T147: More students are risking failing maths.
Leads to oversized HL maths classes	8 (2.2%)	T136: HL class sizes are too big.
Promotes grind culture	7 (1.9%)	T82: It promotes a grinds culture where if a parent throws enough money at the problem the problem will be solved....

In terms of advantages, the main theme noted by 35% of respondents was that the BPI increases the number of students opting for and persisting with Higher Level Senior Cycle mathematics. Related to this, the main disadvantage (also noted by 35%) was that it encourages students, who are deemed not up to the standard required, to persist at Higher Level or opt for Ordinary Level at the latter stages of Senior Cycle. These two leading themes in both data sets, although somewhat conflicting, were at the heart of the narrative that emerged from the thematic analysis. There was a sense from teachers' responses that the teachers found it difficult to separate the main advantage of the BPI from the initiative's main disadvantage. This contradiction may also shed some light on why many respondents (27%) were unsure when asked whether they agreed or disagreed with the BPI. In general, some participating teachers recognised that increasing the numbers studying Higher Level Senior Cycle mathematics is desirable. As noted previously, the high stakes nature of the Leaving Certificate examination means that some students who are capable of studying Higher Level mathematics strategically drop to Ordinary Level so that they can exert more time and effort towards other 'points friendly' subjects. The introduction of the BPI has undoubtedly resulted in many of these students opting for and continuing to study Senior Cycle mathematics at Higher Level.

Some participating teachers also felt that the BPI has motivated students to work harder, rewarded them for the extra time and effort, and through all of this, exposed them to a higher standard of mathematics. However, other participating teachers also recognised that the BPI has had some unintended consequences. On the other hand, the initiative has encouraged some students who were well-placed in terms of ability at Ordinary Level, to now attempt Higher Level mathematics. The fact that a H6 (lowest passing grade at Higher Level) is now worth 15 more points than an O1 (highest grade at Ordinary Level) means that in many cases the reward offsets the risk. In such instances "mathematics is reduced to a vehicle for points" (T2, see Table 8) with little focus on knowledge or enjoyment of the subject. Although struggling, a portion of these students bid to persevere at Higher Level for the duration of the two-year Senior Cycle programme, or else they end up finally succumbing and dropping to Ordinary Level very late. However, some teachers felt that their time at Higher Level will have been marred by increased levels of pressure and anxiety, in addition to an overhanging fear of failing Leaving Certificate mathematics. They also recognised that there is increased pressure on teachers who must cater for groups with greater ranges of ability or attainment in oversized Higher Level Senior Cycle mathematics classes. Inevitably, this may lead to the pace of the class slowing down with the knock-on effect of holding back 'more-able' students. This impact on student profile in Higher Level Senior Cycle mathematics classes is examined further in the next section.

5.4.2 Impact of the BPI on the student profile in Higher Level mathematics classes

In Section 2 of the questionnaire, teachers were asked an open-ended question: "What impact (if any) has the Bonus Points Initiative had on the student profile of your Senior Cycle mathematics groupings?" All 266 teachers in the study offered a response to this question and the majority believed that the BPI had a significant impact on the student profile in their classroom, with only 8 teachers (3.0%) reporting that the BPI had no impact on the student profile in their classroom. The most common change to profile reported by teachers was that the BPI resulted in some students not suited to Higher Level mathematics now persevering with it, often to their own detriment.

> T391: More of the students who struggle with Higher Level mathematics stay and do the exam. They stay purely to earn bonus points. Many stay who would be better served at Ordinary Level. Our failure rate has increased at Higher Level because of this.

A total of 81 teachers (30.5%) alluded to this type of change in student profile. This finding was echoed in the quantitative data when 266 teachers ranked their level of agreement with the statement *Many students who are struggling at Higher Level persist due to the provision of Bonus Points*. The findings linked to this item are presented in Figure 4 below.

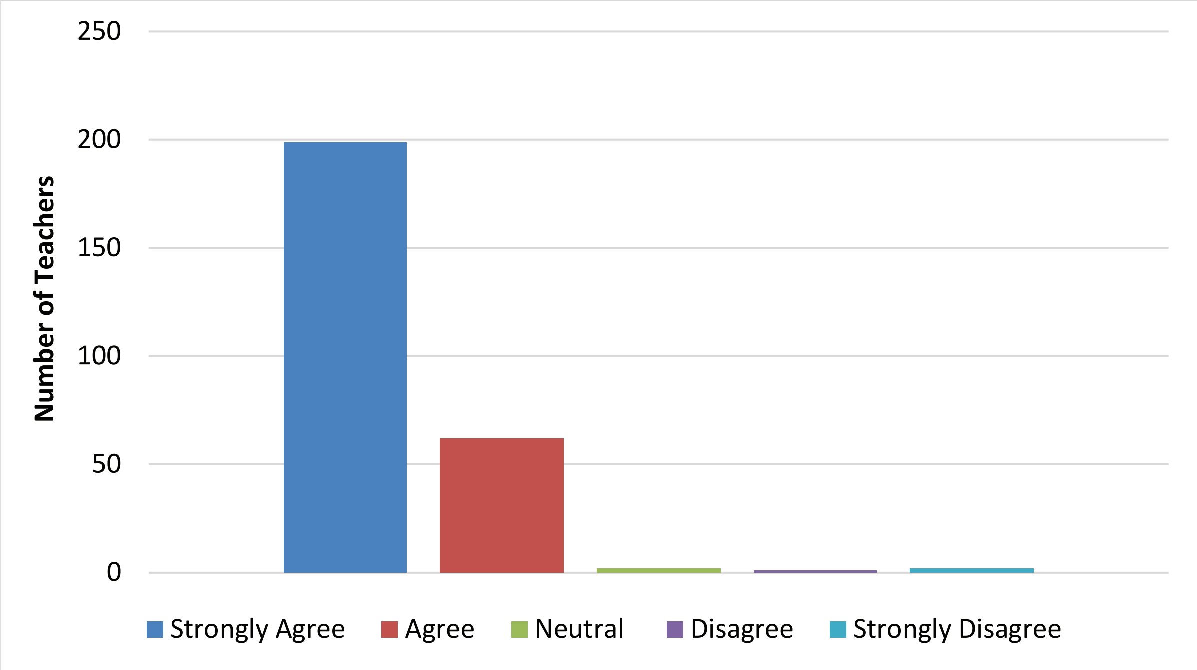

Figure 4. Teachers' responses to the statement "Many students who are struggling at Higher Level persist due to the provision of Bonus Points."

Figure 4 clearly displays the points raised by teachers in response to the open-ended question relating to the change in student profile. Only 3 teachers surveyed disagreed or strongly disagreed that struggling students are persisting with Higher Level mathematics while 261 teachers agreed with this statement, with the vast majority (*n* = 199) strongly agreeing. This feeling was also communicated by some teachers when asked at the end of the survey to outline any other comments they had in relation to the BPI. A large proportion of teachers who responded to this question offered responses suggesting that students are now only pursuing Higher Level as a result of the BPI and persist with it despite encountering many struggles. The following is an example of responses of this nature:

> T116: Students who would not attempt higher level only because of the extra points tend to be lost on the concepts and focus on rote learning.

A further impact of the change in student profile that was reported by a number of teachers (*n* = 61) was in relation to more 'mixed ability' classes. The large number of 'less able' students engaging in Higher Level mathematics has resulted in a much wider 'range of abilities' than would have been the case prior to 2012.

> T431: The range in abilities is far too great. There are students attempting [Higher Level] for the sake of trying to achieve more points, when they are simply not capable and end up doing poorly in their exams.

T52: More students are doing HL and remaining in higher level despite the lack of progress in some cases. The average ability of HL students has decreased.

The change in student profile, suggested by these responses, presents teachers with a series of new challenges to contend with, most notably in terms of catering for increased range of abilities or attainment in the mathematics classroom. This issue relating to wider ranges of attainment is further exacerbated by students persisting with Higher Level mathematics for a longer period of time, before dropping to Ordinary Level. This finding was unearthed when teachers were asked at what point in the Senior Cycle were students most likely to drop from Higher to Ordinary Level. The findings are presented in Figure 5.

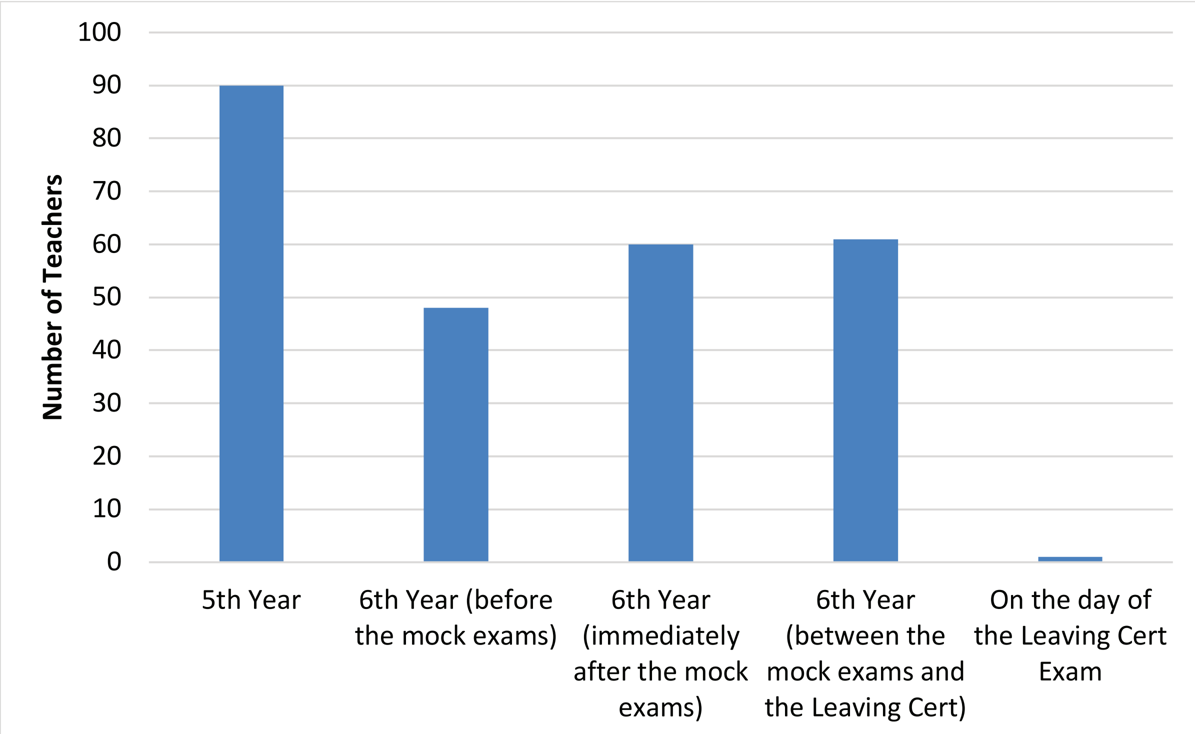

Figure 5. Teachers' responses when asked when the majority of their students who drop to Ordinary Level make this decision

Figure 5 shows a substantial number of teachers (n = 90) reported that the majority of their students who drop from Higher to Ordinary Level do so in the first year of Senior Cycle. The majority of teachers (n = 121) indicated that most of their students who drop to Ordinary Level do so in the three months prior to the Leaving Certificate examinations, once the mock examinations[2] results have been released. This suggests that while there has been a 129.7% increase in the proportion of students sitting the Higher Level paper between 2011 and 2024, there has been an even steeper increase in the number of students opting for Higher Level mathematics study for a major portion of the Senior Cycle. These circumstances exacerbate issues relating to the wider range of attainment in Higher Level mathematics classes. The impact of the BPI on this issue was further confirmed by the vast majority of teachers (87%) who agreed or strongly agreed that the BPI led to students dropping from Higher to Ordinary Level later in Senior Cycle. This again suggests that the typical student profile in Higher Level

[2] Mock examinations are practice examinations that sixth-year students take in early spring [mid-February]. These are modelled on the State Examinations, which students are required to sit at the end of Senior Cycle and are seen as a mechanism to prepare students for these State Examinations (O'Meara & Prendergast, 2017).

mathematics classes has been significantly impacted by the BPI, leading to a wider range of mathematical attainment in the cohort of students studying Higher Level mathematics for a more prolonged period of time. The next section examines whether this change in student profile has influenced the teaching of Higher Level Senior Cycle mathematics.

5.4.3 Impact of the BPI on the teaching of Higher Level Senior Cycle mathematics

In Section 3 of the questionnaire, teachers were asked *What impact (if any) has the Bonus Points Initiative had on your teaching of the Senior Cycle mathematics syllabus? Please elaborate*. This item received responses from 252 of the 266 participants. Similar to the previous section, the analysis of data found that respondents regularly highlighted the greater range of mathematical "abilities" of students in the classroom since the introduction of the BPI. The increased need to support "weaker" students and cater for "mixed ability" cohorts were mentioned directly by 155 respondents (61.5%) – by far the most common code within the data. Respondents also regularly indicated that such a change in the profile of students in Higher Level Senior Cycle mathematics classes has caused them to reduce the pace of their teaching so that they can ensure that students progress sufficiently. This seems to have had a knock-on effect on teaching, as respondents indicated that the level of content explored in the classroom has changed. Content in which they would normally expect students to be proficient needed to be revisited and some complex material avoided due to the lack of readiness of some students to engage with it. Some (13.9%) directly referenced the negative impact this has on the "more able" students in the class as teachers often need to spend more time with those that are struggling to master the content, for example:

> T140: Teaching has slowed down. A lot more students are opting to do [Higher Level] who got [a grade C or a grade D] in Junior Cert. They struggle with Higher Level and we have to move at a much slower pace. This affects the teaching of the more able students.

> T245: I find that it hinders the more capable students in a class. I as a teacher try my best to teach my lessons to a certain ability but with the size of the Maths course & it's complexity other students fall behind & you (I) end up spending valuable time re-explaining terms/ ideas/ methods/ routes to students who don't see the point you're trying to convey to the class. I don't get to ever experiment with my class (topic-wise & methods & further understanding) because of time constraint.

Some questioned the motivation behind the decision of some students to study Higher Level mathematics at Senior Cycle, indicating that there were students who were just "hanging in" so that they could pass and achieve the bonus points. Many teachers reported that students in Higher Level classes now have lower expectations of themselves with many aiming to just reach, rather than exceed, the score required to be awarded bonus points.

> T383: Students are hanging on at higher level to gain bonus points. A lot of students now have the attitude '40% will do'.

Further evidence of this as a potential issue in classrooms was present in the responses to another item in the questionnaire. Participants were asked to respond to the following statement by choosing one of five options indicating their level of agreement or disagreement: "I feel the Bonus Points Initiative is hindering the development of the most capable students in my Higher Level mathematics class". 60.4% of participants either agreed (31.7%) or strongly agreed (28.7%) with this statement, while 15.8% were neutral. 23.8% either disagreed (18.1%) or strongly disagreed (5.7%) with the statement.

These changes in the make-up of Senior Cycle Higher Level class groups have, according to the data, impacted upon teacher workload. Fifty-seven respondents (22.6%) specifically referenced the impact that the BPI has had on them through the need to provide extra classes or support, i.e. the pressure to get all students up to the expected standard and the worry that they are neglecting some "more able" students in order to support "weaker" students. An issue regularly referenced was the challenge of covering the syllabus as this was hampered by the extra time required to support students to progress, as well as the need to revisit material that would typically have been secure before the BPI:

> T195: Range of ability (due to more pupils attempting [Higher Level Senior Cycle]) means it takes longer to get through the syllabus … more differentiation and planning is needed. The result is I find myself teaching to the middle a lot of the time and not having time to explore topics in depth and engage in problem solving to any great extent. The syllabus at [Higher Level] is too long and incorporates many diverse aspects of mathematics which are not suitable for all. More able students are not achieving their potential – time taken up by less able students.

In some instances, this has led to teachers indicating that they are placing greater emphasis upon "getting students over the line", i.e. doing enough so that they pass the Leaving Certificate examination. For example:

> T139: I place huge emphasis on the marking schemes and I tell my students the best approach to take to gain marks rather than solve the problem.

Further to this, 46 respondents (18.3%) indicated that the changes in the typical cohorts they are encountering has challenged their ability to better differentiate instruction, explanations, support, and tasks in their classroom so that they can cater for all needs. This was also often linked to worries about the level of content they could explore as some of the more difficult and inquiry type tasks were bypassed in order to avoid overwhelming some students.

While most respondents indicated that there was an impact on their teaching, 30 respondents (11.9%) indicated that there had been little or no impact. Many of those that elaborated on their answer indicated that they noticed changes in the cohorts but felt it was not best practice to change their approach significantly:

> T124: The Bonus Points didn't make the course content any easier so I continued to teach at the same level.

Five participants (2%) had positive responses to this item as they indicated that the BPI has aided motivation of their students or that the increased ranges of attainment in their classrooms have challenged them to become better teachers.

Teachers in this study reported, as expected, that class sizes have increased noticeably and that this has typically added to the challenges of teaching a Higher Level Senior Cycle mathematics cohort. There also appears to be a pronounced stratification of the students opting to study Higher Level mathematics for Senior Cycle:

> T223: We have streamed the higher level classes to allow better [students] to excel as teacher can go faster, do harder problems … The lower stream benefits also as the teacher can go at a slower pace, emphasise the basics.

However, it is not clear whether this practice is a consequence of increased Higher Level Senior Cycle mathematics cohort sizes. It may always have been common practice in these schools. A small minority of respondents alluded to the greater levels of disruption as there is greater movement between class groups, with students who have initially opted to study mathematics at Higher Level for Senior Cycle deciding to change to Ordinary Level. As discussed previously, this generally happens three months prior to the Leaving Certificate, once the mock examinations results have been released. Such disruption appears to be adding further layers of difficulty to teachers' classroom practice.

5.4.4 Teachers' Perspectives on the Future of the BPI

Teachers were asked what they would like to see happen to the BPI in the future, and three options were provided: maintained in its current form indefinitely; retained but adjusted; or discontinued and not replaced. Of the three options provided, the majority (56%) indicated that they would like to see the BPI *retained but adjusted*. 21% said that they would like to see it *maintained in its current form* and 23% opted for it to be *discontinued and not replaced*. A cross tabulation was also employed here to determine the relationship, if any, between the responses to this item and the teachers' level of agreement with the BPI (see Table 9).

Table 9. Teachers' level of agreement with BPI and what they would like to see happen to it in the future

	Maintained in its current form indefinitely	***Retained but adjusted***	***Discontinued and not replaced***	***Total***
Agree with BPI	50	69	2	121
Disagree with BPI	1	18	52	71
Unsure whether I agree or disagree	4	61	6	71
Total	55	148	60	263

Of the 46% who agreed with the BPI, there were mixed opinions on whether it should be *maintained in its current form* (*n* = 50; 41%) or *retained but adjusted* (*n* = 69; 57%). However, it is clear that the vast majority of the 27% who were unsure about the BPI would like to see it *retained but adjusted* (*n* = 61; 86%). The main reasons for all respondents' choices are summarised in Tables 10, 11, and 12.

Table 10. Maintained in its Current Form (n = 44; f = 53)

Theme	*Total f (%)*	*Sample Responses*
Rewards students for the time and effort required for LC HL	21 (39.6%)	T92: I am glad the undoubted extra time & effort HL maths requires is being rewarded. T431: The bonus points reward students for a subject that generally takes proportionately 25% more time and effort than other subjects.
Increases number of students opting for and continuing LC HL maths	14 (26.4%)	T373: Before the bonus points system students were too quick to give up on HL Maths in my opinion. T49: Bonus points are key incentive for students to pursue the most demanding course for LC.
Raises profile and recognises importance of subject	6 (11.3%)	T45: I believe we should maintain that emphasis on the importance of mathematics. T20: Gives maths a higher profile.
Motivates students to work harder at maths	5 (9.4%)	T432: More students will make a better effort and this raises the overall standard T431: it makes life a bit easier as students try harder in maths as it is worth more to them.

Table 11. Discontinued and Not Replaced (n = 50; f = 59)

Theme	*Total f (%)*	*Sample Responses*
Encourages students who are not up to the standard to stay at LC HL maths	16 (27.1%)	T232: Encourages students who find maths very difficult to stay in HL maths and risk failing the subject T108: Students who are very weak at Maths and should not be doing Higher Level are choosing to do so.
Unfair to prioritise one subject over another	11 (18.6%)	T229: I don't believe that making a subject "more important" is the right approach. T76: Leaving Cert is about many subjects, not just one. Maths should be of equal importance.
Slows down the pace of HL class & holds back more able students	8 (13.5%)	T152: Makes teaching more difficult as catering for the weaker student & strong ones are ignored to a degree T406: Exam questions are becoming easier to answer, stronger students are not being sufficiently challenged and standards have dropped. This must change.
Increases levels of pressure, stress and anxiety on struggling students	6 (10.1%)	T136: Too many students get so stressed about maths as they are hardly passing tests… T168: it is a cause of distress and worry to an increasing number of students who do not have the ability or discipline to achieve in higher level maths…

Table 12. Retained but Adjusted (n = 137; f = 156)

Theme	***Total f (%)***	***Sample Responses***
Points should be awarded on a scale which is dependent on result	56 (35.9%)	T67: Different bonus points depending on grade. Unfair to give a H1 & H5 student same points. T8: the 25 bonus points for a H6 is too tempting for a student who hovers at H6/H7. They stay at H.L. in the hopes of getting over the line & getting the 25 points. If the points were scaled, it would continue to reward high-achievers, reduce the incentive for less able students who do not really grasp the material
Points should only be awarded for higher grades	35 (22.4%)	T217: No bonus points awarded for scraping a pass. T171: Bonus points on offer from H5 upwards. This will eliminate students that are just in the class to get H6 and these students get majority of teachers attention & time which could be focused on students with higher levels of ability.
Points should only be awarded for courses that require mathematics at Third Level	23 (14.7%)	T39: Bonus points should only be rewarded to those who are taking maths related third level courses. T225: Bonus Points could be given only if you applying to a degree course with a substantial Maths content.

As can be seen from these Tables, the themes from teachers' responses in relation to the BPI being *maintained in its current form* (see Table 10) and *discontinued and not replaced* (see Table 11) are closely linked to the main themes that were generated from the responses to the advantages and disadvantages of the BPI, respectively. However, the most noteworthy finding may be in relation to the three themes which were identified from the responses of the majority of teachers (56%) who felt the BPI should be *retained but adjusted*. In terms of future education policy related to the BPI, the three themes outlined in Table 12 are worthy of further consideration.

6. Analysis of Senior Cycle Mathematics Achievement 2008-2024

This section examines the final grades achieved by all candidates between 2008 and 2024 (excluding 2020-2022) in Senior Cycle mathematics at Higher Level. This analysis will aid in answering Research Question 3:

RQ3: Given the significant increase in students opting to complete Senior Cycle mathematics at Higher Level in the period 2011 to 2024, what impact, if any, has this change had on grades awarded in mathematics at this level?

6.1 Methods

The data analysed in this section were sourced from the State Examination Commission website (www.examinations.ie). Each year, the total number of students achieving the range of final grades in mathematics at Higher (grades H1 to H8), Ordinary (grades O1 to O8), and Foundation levels are published on this site. These data for the years from 2008 up to and including 2024 (excluding 2020-2022) were collated, cleaned, and organised in a Microsoft Excel file in order to complete descriptive and inferential statistical analyses. For this period, there were 667,687 students who completed their mathematics Leaving Certificate examination at either Higher or Ordinary Level in this database. The time period (2008-2024) was chosen in order to observe trends before and after the introduction of the revised Senior Cycle mathematics curriculum and the BPI – both of which came into effect for those completing their Leaving Certificate examinations in 2012.

The years 2020 to 2022 inclusive were not included in the database due to the inconsistent nature of assessment during those years. Predicted grades were applied in 2020 for the vast majority of students and for some in 2021 due to restrictions on examinations caused by measures related to the COVID-19 pandemic. Adjustments made to the 2021 and 2022 examination papers entailed a reduction in content due to interruptions in learning for each cohort over the previous years (SEC 2024). In 2023, the examination papers (Paper 1 and Paper 2) were adjusted somewhat as there was some choice in both papers compared to no choice in equivalent examinations before 2020. Students could choose five questions from six in section A and three questions from four in section B in each paper in 2023 (State Examinations Commission, 2022a). The authors deemed these arrangements to be sufficiently similar as to be comparable with examinations before 2020 and in 2024, and thus included this data in the analysis.

Grades were compared across the selected time period (2008-2024) even though the grading scheme was revised in 2017. This was possible as there was still significant alignment between grade boundaries and grades awarded even though most grade boundaries were in 10 percentage point increments in the new scheme compared to the typical 5 percentage point increments in the old scheme. In the new grading scheme at Higher Level (H1 to H8), a H1 was equivalent to an A1 in the prior scheme (see McCoy et al., 2019). The grade boundary (80% to < 90%) for H2 was equivalent to A2 and B1 grades combined from the prior scheme. Similarly, H3 was equivalent to a B2 and B3 combined (see Table 13). Failing grades (H7 and H8) were grouped in the analysis and equivalent to E, F, and NG (0% to < 40%) in the previous scheme. This was required as grade boundaries at this end of the scale did not line up exactly when comparing the current system to the previous scheme, e.g. an E grade (25% to < 40%) was not equivalent to a H7 grade (30% to < 40%).

Table 13. Alignment of present grading scheme (2017-present) with previous grading scheme (1992-2016) for the Leaving Certificate examinations.

<table>
<tr><th>Overall Examination Score</th><th>Current Higher Level Grading Scheme (2017-present)</th><th>Previous Higher Level Grading Scheme (1992-2016)</th></tr>
<tr><td>≥ 90% to 100%</td><td>H1</td><td>A1</td></tr>
<tr><td>≥ 80% and < 90%</td><td>H2</td><td>A2 & B1</td></tr>
<tr><td>≥ 70% and < 80%</td><td>H3</td><td>B2 & B3</td></tr>
<tr><td>≥ 60% and < 70%</td><td>H4</td><td>C1 & C2</td></tr>
<tr><td>≥ 50% and < 60%</td><td>H5</td><td>C3 & D1</td></tr>
<tr><td>≥ 40% and < 50%</td><td>H6</td><td>D2 & D3</td></tr>
<tr><td>≥ 30% and < 40%</td><td>H7</td><td rowspan="2">E, F, NG</td></tr>
<tr><td>≥ 0% and < 30%</td><td>H8</td></tr>
</table>

6.2 Analysis of Higher Level Senior Cycle Mathematics Cohorts

Analysis of the grades achieved by each Higher Level mathematics Senior Cycle cohort from 2008 to 2019 demonstrates some shifts in the grades achieved and, particularly, the proportion of failing grades (see Fig. 6). The proportions achieving the top grade at this level, i.e. a H1 grade (90% or better), fell from a baseline of 6-7% to 3.1% in 2012, however, this proportion recovered to a typical level of 6% by 2019. H2 grades had a typical baseline of 15-17%, this dropped to a typical level of 11-14.3% from 2012 to 2019.

H3 grades typically had a baseline of 21-24% from 2008 to 2011 which fell to a typical level of 16-19% in the 2012-2019 period. H4 grades typically had a baseline of 23-25% from 2008 to 2011 which increased initially in 2012 and 2013 and then fell slightly to a typical level of 22-23% thereafter.

Lower passing grades, H5 and H6 (40% to less than 60%) clearly increased in the period after the introduction of the BPI as did failing grades, H7 and H8 (less than 40%). Failing grades had a baseline of 3-4.3% from 2008 to 2011 which increased gradually to a typical level of 7.2-8.2% in the latter stages of the 2012-2019 period.

Overall, small declines are seen in the proportions of H2 and H3 grades, with relatively moderate increases in H5 and H6 grades as well as gradual but significant increases in failing grades (H7 and H8), particularly from 2017 to 2019.

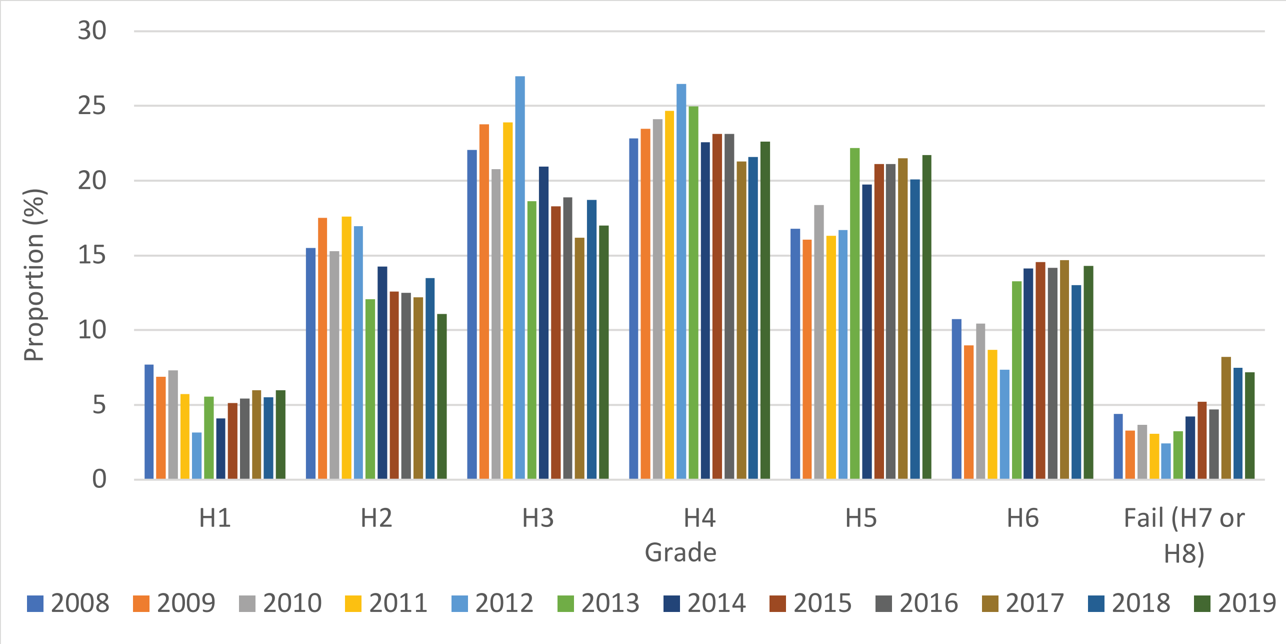

Figure 6. Proportion achieving Higher Level grades (H1-H8) from 2008-2019 from the cohort of Higher Level students.

When the proportions for 2023 and 2024 are added (see Fig. 7), the situation changes significantly, particularly at each end of the spectrum of grades. H1 grades accounted for 10.9% in 2023 and 12.6% in 2024 compared to 6% in 2019. H2 and H3 grades also demonstrate noticeable increases when compared to 2019. The proportions of H5 and H6 grades dropped considerably when 2019 is compared to 2023 and 2024. Failing grades (H7 and H8) fell significantly to 2.8% in 2023 and 3.4% in 2024 compared with a typical level of 7.2-8.2% in the period 2017-2019.

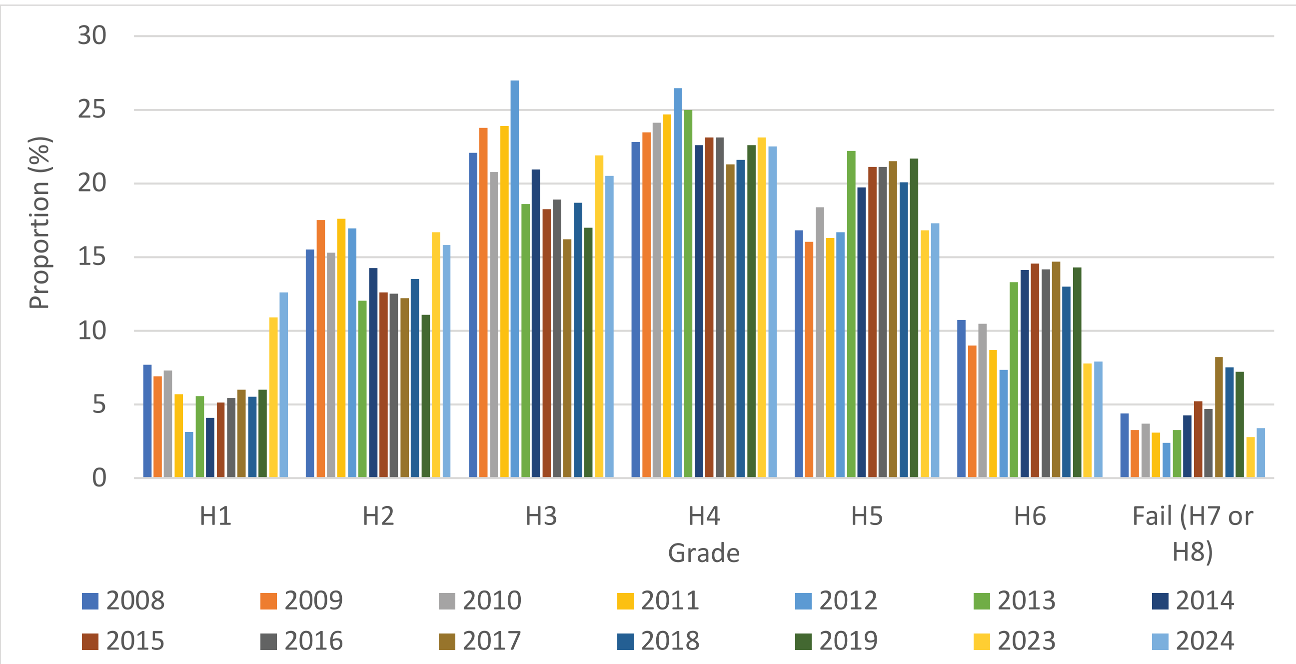

Figure 7. Proportion achieving Higher Level grades (H1-H8) from 2008-2024 from the cohort of students. Note: the years 2020-2022 are excluded.

6.3 Analysis of Combined Higher and Ordinary Level Senior Cycle Mathematics Cohorts

While comparisons of Higher Level cohorts year on year from 2008 to 2024 are useful, the significant changes to the make-up of these cohorts renders such comparisons unreliable. The proportion of students opting to complete their Leaving Certificate mathematics examinations at Higher Level has changed considerably in the period 2008 to 2024, rising from 17% to 36.3% (see Fig. 1). Therefore, these cohorts are not strictly comparable. However, the proportion of students opting to complete their Leaving Certificate mathematics examinations at either Higher Level or Ordinary Level (ranging from 87.9% to 94.1%) remained relatively consistent over this time-period. It is this cohort which is comparable year on year as one would not expect the general mathematical capabilities of these groups to vary significantly from year to year. Typical performance of 15-year-old students in PISA mathematics assessments in Ireland would appear to support this claim. 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) (Educational Research Centre 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 (Educational Research Centre 2023).

Given that the mathematical capabilities of the combined Higher and Ordinary Level cohorts are unlikely to have varied much from year to year, one would expect that the proportions of students achieving at the upper end of the Higher Level grading spectrum would remain consistent. This was not the case. Students achieving a H3 grade or better (70% or better at Higher Level) increased from a typical baseline of 7.9-8.9% in the years 2008 to 2011 to values between 10.5% and 13.2% during the period 2012 to 2019 (see Fig. 8). This figure rose to 18.9% in both 2023 and 2024.

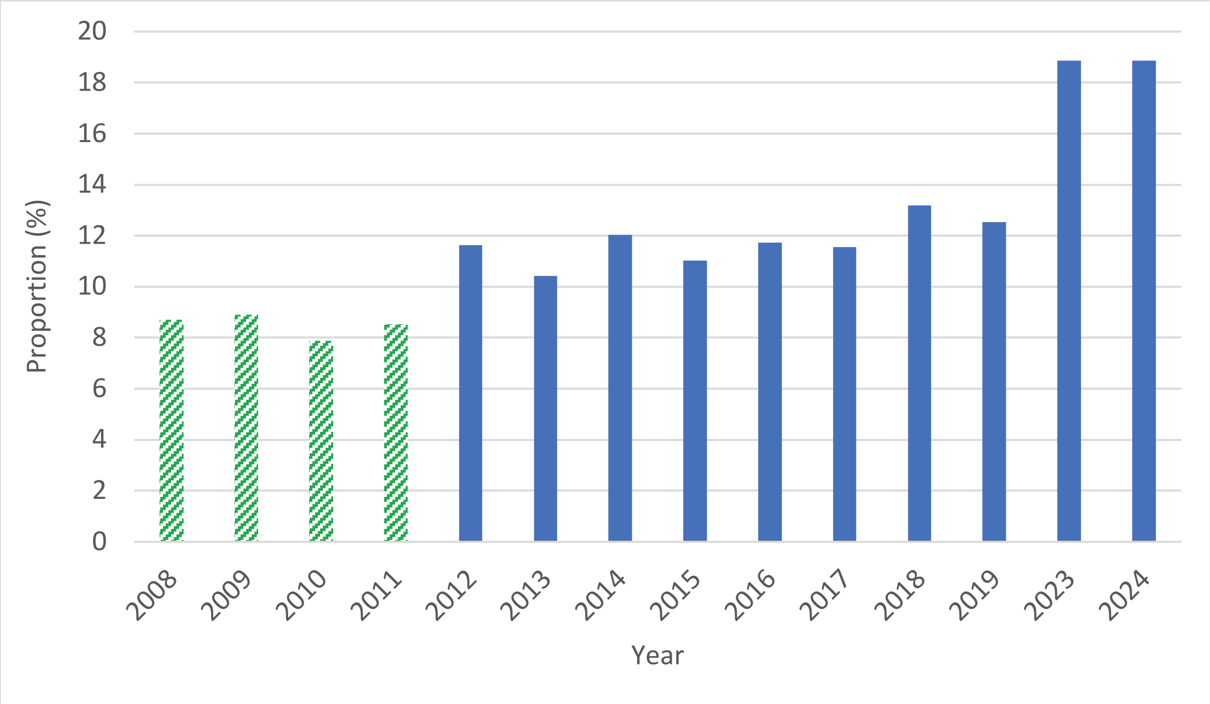

Figure 8. Proportion of students completing their Leaving Certificate mathematics examinations at either Higher or Ordinary Level achieving a H3 Grade or better in the period 2008-2024[3].

[3] Note: 2020 to 2022 omitted due to the irregular nature of examinations in those years caused by factors related to the COVID-19 pandemic.

When comparing 2008 to 2019, there is a 44% increase in the proportion of all Higher and Ordinary Level students achieving a H3 grade or better in their Leaving Certificate mathematics examinations. When 2008 is compared to 2024, there is a 116% increase in the proportion of all Higher and Ordinary Level students achieving a H3 grade or better in their Leaving Certificate mathematics examinations.

Further consideration of these grades at a more granular level (see Fig. 9) provides further context for the variations in awarding H1, H2, and H3 grades from 2008 to 2024. H1 grades dipped in 2012 but then recovered and quickly surpassed the typical level prior to 2012. The proportion of all Higher and Ordinary Level students achieving a H1 grade rose from 1.5% in 2008 to 2.2% in 2019 and 4.9% in 2024. The proportion of H2 grades rose from 3% in 2008 to 4.1% in 2019 and 6.1% in 2024. The proportion of H3 grades rose from 4.2% in 2008 to 6.2% in 2019 and 7.9% in 2024.

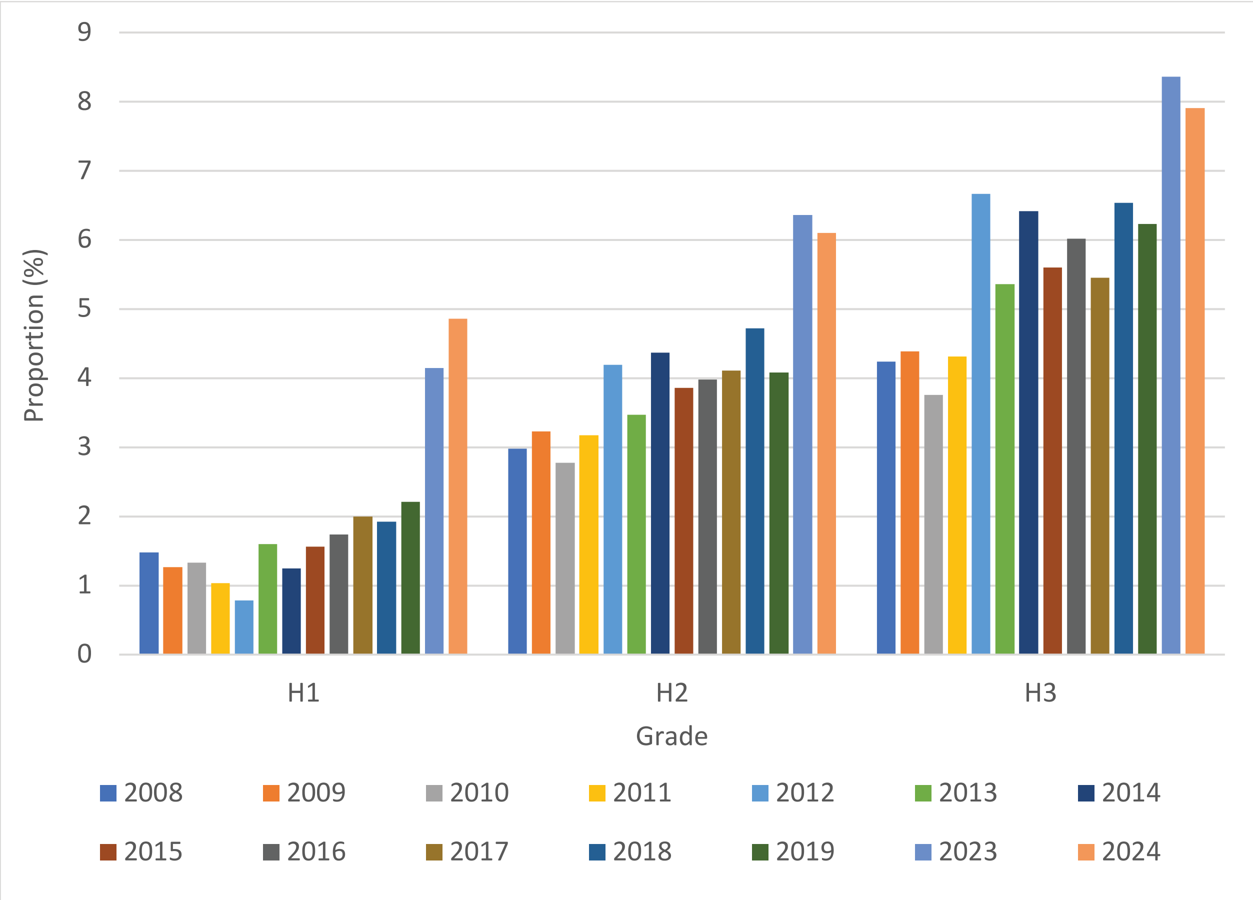

Figure 9. Proportion of students (Higher and Ordinary combined) achieving H1, H2, H3 grades (2008-2024). Note: 2020 to 2022 omitted due to the irregular nature of examinations in those years caused by factors related to the COVID-19 pandemic.

Overall, there is a clear increase in the proportions of students from the combined Higher and Ordinary Level cohorts achieving H1, H2, or H3 grades from 2011 to 2019, and a further significant increase from 2019 to 2024.

7. Discussion and Recommendations

In this section, we address the research questions posed previously in light of our research and findings and make recommendations to address any issues highlighted through this research. The research questions are:

- RQ1: What motivates Senior Cycle students in Ireland to opt to study mathematics at Higher Level?
- RQ2: What are teachers' perceptions of the Bonus Points Initiative in mathematics and its impact on their experiences in the classroom?
- RQ3: Given the significant increase in students opting to complete Senior Cycle mathematics at Higher Level in the period 2011 to 2024, what impact, if any, has this change had on grades awarded in mathematics at this level?

Each research question is addressed in the following sub-sections: RQ1 in 7.1, RQ2 in 7.2, and RQ3 in 7.4. The limitations of this research are also addressed in 7.5.

7.1 Student Motivation to Study Higher Level Mathematics

Teachers appear to recognise the positive impact that the BPI has had, given that more of the respondents in the study agree with the BPI (46%) than disagree with it (27%). However, a significant majority of respondents indicated they felt there was a need to either discontinue the initiative (27%) or review it (56%). One issue which may be driving this view is the impact the BPI has on student motivation to study mathematics at Higher Level. The availability of 25 bonus points appears to have been a key reason for the 129.7% increase in the proportion of students completing Higher Level mathematics at Senior Cycle between 2011 and 2024. In our study, 68.4% of the 893 student responses indicated that the BPI was the most influential factor in their decision to opt for Higher Level mathematics. This indicates that the key motivating factors for most students to study mathematics are extrinsic in nature. McCoy et al. (2019, p.43) noted a similar observation as they highlighted responses from some Senior Cycle students to indicate it was “the only incentive to remain in higher level”. The National Council for Curriculum and Assessment (2024, p.12) indicated that bonus points attracted many students to opt for Higher Level mathematics “against the advice of their teacher”.

Relying heavily on motivating factors of an extrinsic rather than an intrinsic nature is not recommended. Intrinsic motivation is determined by level of interest coupled with satisfaction and pleasure derived from a task. Enhanced intrinsic motivation has been demonstrated to have significant and lasting effects on student achievement in mathematics over and above the effects of external rewards which boost extrinsic motivation (Liu 2021, Murayama, Pekrun, Lichtenfeld, and Vom Hofe, 2013; Zhu and Leung, 2011). An external reward such as bonus points may lead more students to engage in Higher Level mathematics, however, this may not provide sufficient or lasting motivation to engage effectively in deep learning of the subject and may lead many to focus on just doing enough to achieve a passing grade to gain the reward of bonus points. These are issues which have been highlighted by teachers in this study (see section 5.4.3 for example).

Singapore and New Zealand have found success in the past by providing a variety of pathways for the study of advanced mathematics at secondary level which appears to have enabled high participation rates (Hodgen et al., 2013). Such an approach can enhance the value students place on studying mathematics as they may tailor their studies to suit their future tertiary courses and/or career, thus boosting intrinsic motivation. In England, recommendations for boosting the 'excellence stream' in mathematics include improved teaching practices, enhanced outreach and engagement through virtual schools, and the provision of greater emphasis on the career pathways in mathematics (Noyes et al., 2023). This latter recommendation has shown some promise already in Ireland as 'Career Mathways', an initiative to highlight the value of mathematics in a variety of careers, had a moderate positive impact on secondary students' perceptions of the usefulness of mathematics (O'Meara et al., 2022). Similarly, outreach and engagement programmes in Ireland such as 'Maths Sparks' have shown encouraging initial impacts on student attitudes and confidence within the subject through positive learning experiences (Ní Shúilleabháin et al., 2020).

Teachers and other stakeholders appear to recognise the potential need for an external reward such as bonus points to encourage students to take on a challenge such as Higher Level mathematics (Prendergast et al., 2020; McCoy et al., 2019). However, such rewards need to be carefully designed to elicit motivation to achieve deep understanding of the content rather than superficial learning to attain a passing grade. This needs to be coupled with greater emphasis on policies which help boost students' intrinsic motivation to embrace this challenge.

Recommendation: Policy makers should re-assess the nature of bonus points to reduce the incentive to aim for a low passing grade. They should link the number of bonus points awarded to the grade achieved, i.e. reward higher grades with a greater number of bonus points. In tandem, more focus should be placed on interventions which enhance students' attitudes towards mathematics, thereby boosting intrinsic motivation to study the subject at Higher Level. This would be preferable to policies which aim to enhance extrinsic motivation such as bonus points (in their current form).

7.2 Teacher Experiences of the Changing Nature of Higher Level Mathematics Cohorts

Since 2010, Higher Level Senior Cycle mathematics teachers have been challenged to adapt to a significant change in the curriculum while also adjusting to the changing nature of the cohorts they would typically teach at this level. These teachers have indicated that their workloads increased due to the growing need to support students struggling with mathematics and a more pronounced need to differentiate their instruction to enable all students to make progress within this wider range of attainment levels. With these challenges came concerns that the pace of instruction is not sufficient to cover the syllabus in a suitable time period. In addition, opportunities to challenge higher attaining students in current circumstances are not as plentiful. The National Council for Curriculum and Assessment (2024, p.12) received similar feedback from teachers as they highlighted that bonus points have "skewed the range of abilities in both higher and ordinary level mathematics classes", thus leading to challenges in relation to pace of lessons.

Given that the proportion of students completing Higher Level mathematics at Senior Cycle increased by 129.7% between 2011 and 2024, it is not surprising that teachers' experiences of teaching these cohorts has changed significantly also. If teachers are challenged to manage such a substantial change in the classroom, then they must be supported to do so. Taylor et al. (2017) recommend that teachers who are challenged to adapt to wider ranges of attainment need guidance and exemplars in addition to appropriate continuing professional development in order to achieve the best outcomes for their students.

The current review of the Senior Cycle mathematics curriculum is a timely opportunity to address these issues, since any changes in the curriculum are likely to require the provision of professional development to support teachers to navigate these changes. If bonus points are retained, then teachers must be given sufficient professional development opportunities to fully engage and support the widening range of student attainment levels they are encountering in Higher Level Senior Cycle mathematics classrooms.

Recommendation: The Department of Education should provide continuous professional development for post-primary mathematics teachers to enhance their skills in differentiated instruction and support for struggling students. Consideration needs to be given to how teachers and students may be effectively supported as they adapt to the challenges of Higher Level mathematics, particularly in light of the changing nature of typical Senior Cycle mathematics cohorts at this level.

7.3 Addressing Barriers to Progression in Higher Level Mathematics

Our findings indicate that female students tend to display lower levels of self-efficacy in relation to their achievement in mathematics despite similar or better achievement levels when compared to males. While more research is needed in this respect to come to a definitive conclusion, it is an important issue which needs to be highlighted. McCoy et al. (2022) concluded as part of their national longitudinal study of 8,568 nine-year-old children in Ireland that mathematics performance of girls (when compared to boys) is underestimated by both mothers and teachers. They indicate that such gender stereotyping can have knock on effects for mathematics engagement and selection of STEM careers in the future. Examining and addressing this issue at Senior Cycle, as well as earlier in students' education, should enable more females to confidently select Higher Level mathematics.

Similarly, understanding the breadth and impact of mathematics anxiety at post-primary level should be a priority so that barriers of this nature can be reduced or removed for students. Ryan et al. (2019, 2023) have tracked the impact of mathematics anxiety and highlighted its presence amongst mature university students in Ireland. Perkins et al. (2013) noted in their analysis of PISA 2012 results that 15-year-old students in Ireland demonstrated level of mathematics anxiety statistically significantly higher than average. Mathematics anxiety was higher amongst females when compared to males in this dataset also. There are strong negative links between mathematics anxiety and students' motivation to learn mathematics and between mathematics anxiety and performance in mathematics (Li et al., 2021; Zhang et al., 2019). Aiding parents and teachers to enable positive experiences and attitudes towards mathematics is vital in this respect, as is signposting achievements to demonstrate meaningful progress in the subject.

Recommendation: Further funded research through appropriate agencies is needed to establish the breadth and impact of barriers to studying mathematics at Higher Level in post-primary schools, including gender differences and mathematics anxiety, in order to address these barriers effectively.

7.4 Student Achievement in Higher Level Senior Cycle Mathematics

The attainment referencing model applied to Leaving Certificate examination grade distribution "relies for its validity on the similar cohort adage" (State Examinations Commission, 2022b, p.25). The similar cohort adage presumes that cohorts of students are similar from year to year. However, this was not the case for Higher Level Senior Cycle mathematics cohorts over the course of the period from 2011 to 2024. Cohorts may have changed somewhat gradually from year to year but the change in cohorts over slightly longer periods was significant. For example, in the first 5 years of this period (2011-2016), the proportion completing Higher Level mathematics at Senior Cycle increased by 80.4% (15.8% up to 28.5%). The increase from 2011 to 2024 was 129.7%. Clearly, the 2011 cohort of students completing Higher Level Senior Cycle mathematics was significantly different to subsequent cohorts and this difference became more pronounced with each cohort, thus violating the similar cohort adage which the SEC relies upon for the validity of attainment referencing.

The increase in proportion of students opting for Higher Level likely came from those that would typically have been on the border between strong achievement at Ordinary Level and lower achievement at Higher Level (State Examinations Commission, 2015). The Chief Examiner's report in 2015 considered the goal of reaching a proportion of 30% of students opting for Higher Level mathematics by 2020 and cautioned that "such a steep change over such a short timeframe necessarily has a very significant impact on the grade distributions that might be expected at the various levels" (State Examinations Commission, 2015, p.9). This report indicated an expectation for an increase in the proportion of low grades achieved at Higher Level in Leaving Certificate mathematics in subsequent years. While there was some increase in the proportion of failing grades (H7 and H8) after 2015, there were no notable increases in the proportions of Higher Level students achieving H4, H5, or H6 grades (see Fig. 7).

The combination of grades awarded from year to year maintaining a certain level of consistency (see Fig. 6) and the aforementioned transformation in Higher Level Senior Cycle mathematics cohorts resulted in a significant increase in the number of H1 to H3 grades awarded. When comparing 2008 to 2019, there is a 44% increase in the proportion of all Higher and Ordinary Level students achieving a H3 grade or better in their Leaving Certificate mathematics examinations (see Fig. 8). Such an increase can be explained in a number of ways, e.g. by improved student performance in mathematics, a decline in standards, or a combination of both. International assessments of mathematics outlined previously (i.e. PISA and TIMSS) indicate that secondary level students in Ireland have performed relatively consistently since 2003, so there is little evidence to suggest that recent Senior Cycle cohorts are significantly different to previous cohorts. As such, we can only conclude that standards have declined to enable such a significant increase in grades awarded at the upper end of Higher Level Leaving Certificate Mathematics up to 2019.

The further increase in grades from 2020 to 2024 is likely due in part to the issues caused by predicted grades applied in 2020 and 2021, as well as the reduction in content examined in 2022. Since then, the State Examination Commission (2024, pp.3-4) have adjusted grades to ensure a degree of fairness for students:

> "The specific parameters (i.e. the marks to be added) were determined so that the overall results on the aggregate are at the same level as last year and that there is no further grade inflation and in order to give the best possible match to the grade distributions across all grades at each level."

As outlined previously, when 2008 is compared to 2024, there is a 116% increase in the proportion of all Higher and Ordinary Level students achieving a H3 grade or better in their Leaving Certificate mathematics examinations (see Fig. 8). While some of this inflation can very likely be attributed to the impact of the predicted grades policy, this trend of grade inflation was already evident prior to 2020.

Grades are intended to reflect student effort and ability while also acting as predictors of future educational attainment and value to the workforce (Pattison et al., 2013). Grade inflation can lead to a loss of confidence amongst stakeholders regarding the capacity for grades to provide valid and reliable information about students. This can lead to issues including impacts on the value of entry requirements for Higher Education courses. Students may be admitted to courses for which they are not sufficiently mathematically prepared – an issue which has been highlighted in Ireland recently (e.g. Treacy and Faulkner, 2015; STEM Education Review Group, 2016; Fitzmaurice et al., 2021). Similarly, inappropriate grade rewards for low achieving students can reduce motivation for higher attaining students to reach their full potential as they recognise they may not need to do so in order to achieve a high grade (Chowdhury 2018).

Recommendation: The State Examinations Commission should review the grades awarded in Higher Level Senior Cycle mathematics to establish the level of grade inflation and the impact this has on Higher Education as well as the overall standards of post-primary mathematics. Further research on the impact of this grade inflation on stakeholders in Higher Education needs to be conducted also in order to gauge the downstream impact.

7.5 Limitations of the Study

The research outlined in this report has some limitations which need to be considered. Data gathered through both the teacher questionnaire and student questionnaire may be somewhat dated as these were administered in 2018 and 2019. As is evident from our previous analysis, Senior Cycle Higher Level mathematics cohorts have continued to change since then as increased proportions of students opted to study mathematics at this level subsequently (32.9% in 2019, 36.3% in 2024). However, this change in cohorts is somewhat minor and it is to be expected that similar issues highlighted then by teachers and attitudes displayed by students continue to persist.

While there were a large number of respondents to the teacher survey (n = 266), the sample was self-selecting as teachers could decide whether or not to respond. It may have been the case that respondents held strong views on the BPI and were thus more motivated to complete and return the questionnaire. This may have resulted in some element of bias in the sample.

8. Conclusion: The Overall Impact of Bonus Points

The introduction of the BPI has clearly had an impact on participation in Higher Level Senior Cycle mathematics as this policy has coincided with a 129.7% increase in the proportion of students completing mathematics at this level between 2011 and 2024. On the surface, this suggests this policy has been a major success. However, the research findings presented in this report indicate that there are important side-effects of the BPI negatively affecting the quality of teaching and learning in mathematics at Senior Cycle. Therefore, when the overall impact of the BPI is examined, the influence of this initiative on teachers and students should be strongly considered.

Teachers of Higher Level Senior Cycle mathematics are experiencing increased workloads and stress due to widening levels of attainment in their classrooms leading to the need for greater support for some students to the potential detriment of higher attaining students. Teachers' responses to the evolving situation in their classrooms, e.g. alterations to the pace of instruction, have led to concerns regarding the time available to cover the syllabus and opportunities to engage higher attaining students effectively. This issue compounds year on year with the continued growth in the proportion of students opting for Higher Level mathematics at Senior Cycle.

Students' decisions to opt for Higher Level mathematics at Senior Cycle seem to be pragmatic in nature, particularly for those that would have typically been on the borderline between Ordinary and Higher Level. The BPI is clearly a significant incentive through which a substantial number of extra CAO points can be obtained with a passing grade. However, extrinsic motivation of this nature is rarely lasting and can lead some to make decisions for the wrong reasons. If the goal is to enhance overall student capabilities in mathematics, then inculcating a culture of aiming for 40% or better is unlikely to lead to positive outcomes.

The findings of this report support the conclusion that an ongoing significant transformation in student mathematics attainment profile of a typical Higher Level Senior Cycle mathematics cohort has an impact on attainment standards. When the proportions of grades awarded generally maintain consistency from year to year, as is common when applying attainment referencing, a significant change in the makeup of a typical cohort can have a substantial impact on the standards linked to those grades. The increase in students opting for Higher Level mathematics at Senior Cycle between 2011 and 2024 is very likely to have been increased by a stratum of students who would typically have been on the border between attainment at the upper end of Ordinary Level and the lower end of Higher Level before the BPI was introduced. With more students of this profile combined with relatively consistent proportions of grade distribution from year to year, it is not surprising that grade inflation has been detected.

It is understandable in a system with such a framework that there would be a gradual decline in standards to adapt to the challenge posed by the constantly evolving profile of each successive cohort. There is provision for dealing with this issue within attainment referencing as expert judgement is used along with striving for consistency in grades awarded from year to year to ensure standards do not decline. However, it is still possible that there was a slow creep in the reduction of standards from year to year since the introduction of the BPI, as the marking team maintained relative consistency in grades awarded while making concessions in standards expected. Policy makers must therefore decide if this trend should be allowed to continue and adapt accordingly. However, it is rare that fostering conditions which lead to a decline in overall standards results in positive outcomes for any education system.

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