A ‘new normal’: Teachers’ experiences of the day-to-day impact of incentivising the study of advanced mathematics

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This article examines teachers’ perspectives of the impact in the classroom of a novel approach to boosting participation in upper secondary (Senior Cycle) mathematics in Ireland at the most advanced level (Higher Level). This approach, termed the Bonus Points Initiative (BPI), is an incentive which has coincided with a gradual increase from 16% to 31.5% in the proportion of student cohorts opting to complete Higher Level Senior Cycle mathematics studies in Ireland between 2012 and 2018. Qualitative and quantitative data for this study was gathered through questionnaire responses from 266 teachers of Higher Level Senior Cycle mathematics across Ireland. Data analysis led to the identification of a number of emerging challenges for teachers, mainly due to widening ranges of attainment in their classrooms. These challenges include addition to workloads, worries that higher attaining students are being neglected, pressure to cover the syllabus, and concerns with regards to pace of instruction.

Keywords: advanced secondary mathematics; incentives; classroom practice; mathematics participation.

Introduction

Improving mathematics participation and achievement at upper secondary level is an area of considerable focus amongst education systems worldwide (Hodgen, Marks, & Pepper, 2013; Noyes and Adkins, 2016). Deficits in the numbers of students completing secondary education with the skills in STEM subjects (Science, Technology, Engineering, and Mathematics) desired by employers have been highlighted as causes for concern in Western nations (The Royal Society, 2014; Hine, 2019). In Ireland, similar concerns have been raised in relation to the mathematical skills and knowledge demonstrated by students upon completion of secondary education and entry into third level education (Department of Education and Skills, 2017; Treacy, Faulkner & Prendergast 2016). In response, the Department of Education and Skills (DES) have set out the goal that the country will become a leader in Europe with regards to developing and deploying STEM talent (Department of

Education and Skills, 2017). The means by which the education system in Ireland has worked and continues to work towards this goal are a combination of typical and somewhat novel strategies; the provision and subsequent impact of which may hold important lessons for the international mathematics education community. Key changes made include a significant revision of the curricula for mathematics at secondary level and the introduction of an incentive to study advanced mathematics at upper secondary level. While the former is a typical adjustment made by many education systems (Noyes, Wake, & Drake, 2011; Schoenfeld, 2004), the latter initiative is novel and will be the focus of this article. The impact that this incentive to study advanced mathematics at upper secondary level has had on the goal of improving mathematics participation and achievement at this level will be discussed. Particular focus will be placed on the impact of this incentive on teachers and their experiences in upper secondary mathematics classrooms in Ireland.

Context

Secondary mathematics education in Ireland has been subject to significant change in the past decade. New curricula have been introduced at Junior Cycle (initial three years of secondary education, ages 12-15) and Senior Cycle (final two years of secondary education, typically ages 16-18). These curricula, gradually phased in from 2010 onwards, placed greater emphasis on problem solving and real world applications of mathematics (Department of Education and Skills, 2010). This was a significant shift away from the previous curricula which emphasised procedural fluency and had remained largely unchanged since the 1960s (Oldham, 2001). It was argued that this shift would challenge pupils to apply their understanding in different contexts thus enhancing their depth of understanding, rather than applying procedures without understanding which was a concern raised regularly in relation to the previous curricula (NCCA 2012). Enhanced focus has been placed on the study of statistics and probability at Senior Cycle, whilst topics such as vectors and matrices have been excluded from the new curriculum (NCCA, 2012).

The manner in which students are assessed upon completion of their Junior Cycle and Senior Cycle studies continues to be in the form of high-stakes summative examinations which account for 100% of the final grade awarded to each student. The content of the Leaving Certificate mathematics examination – the terminal examination for Senior Cycle students – changed gradually between 2012 and 2014 as elements of the new curriculum were phased in each year. Similarly, the content of the Junior Certificate mathematics examination – the terminal examination for Junior Cycle students – changed gradually between 2013 and 2015.

Participation in upper secondary mathematics is a challenge for education systems in nations such as the UK and others across the EU (Caprile, Palmén, Sanz, & Dente, 2015; Hillman, 2014; Noyes and Adkins, 2016; Smith, 2017), however this is not the case in Ireland. Even though mathematics is not strictly a compulsory subject for the Leaving Certificate examinations, it is treated as such by schools due to the fact that it is a gatekeeper for the vast majority of third-level courses. Thus, studying mathematics for Senior Cycle is typically expected of all students. This is reflected in the proportion of Leaving Certificate candidates completing mathematics examinations each year (e.g. 97% in 2016 and 99% in 2017) at one of three levels – Higher, Ordinary, and Foundation (State Examinations Commission, 2018). It must also be noted that, even though there are some alternative routes, the Leaving Certificate examinations route is by far the most popular for students completing state examinations at this level of education as it typically accounts for approximately 94% of all candidates completing state examinations at this level of education each year.

Given that the uptake in mathematics study for Senior Cycle does not present a significant challenge, increasing the number of students studying mathematics at the most advanced level (Higher Level) would be one potential strategy to make improvements in overall mathematics performance amongst cohorts completing the Leaving Certificate examinations. This was the motivation for a significant policy change in 2012 which accompanied the aforementioned curriculum change – the introduction of the Bonus Points Initiative (BPI).

Bonus Points Initiative

The number of points achieved by a student in their Leaving Certificate examinations is a significant factor in determining the third level courses to which they may be admitted. The maximum number of points achievable in the Leaving Certificate examinations is 625. Students are awarded a certain number of points based on the grade achieved in a given Leaving Certificate examination (see Table 1). A student's Leaving Certificate points total is determined by tallying the points achieved in a maximum of six subjects. These points totals, along with minimum entry requirements, play a significant role in determining whether a student gains entry into their preferred course in Higher Education Institutions in Ireland.

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

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

The Bonus Points Initiative (BPI) was put into practice for the 2012 Leaving Certificate examinations and has been in place since. Students who achieve at least a passing grade (≥ 40%) in their Higher Level Leaving Certificate mathematics examination are awarded 25 points in addition to the points they achieve for their given grade (see Table 1) (Central Applications Office, n.d.). For example, a student achieving a grade H6 would be awarded 46 points for that grade plus 25 points through the BPI, thus resulting in a total of 71 points. Bonus points are not awarded for grades H7 or H8. Students can, with the BPI in place, achieve a maximum 125 points in mathematics compared to a maximum of 100 points in all other subjects within the Leaving Certificate examinations.

The motivation for the provision of the BPI is to encourage more students to opt to study mathematics at Higher Level for Senior Cycle during their secondary education (Treacy, 2018). This also aligns with key objectives outlined by the Department of Education as they have recently highlighted the goal of increasing uptake in the study of STEM subjects, particularly mathematics, physics, and chemistry (Department of Education and Skills, 2016, 2017). They hope that the realisation of this objective would ultimately lead to the provision of "an engaged society and a highly-skilled workforce" (Department of Education and Skills, 2017, p. 5).

It would appear that the BPI is succeeding in its intended aim as the proportion of students opting to study Higher Level mathematics for the Leaving Certificate examinations has increased from a typical proportion of about 16% (8,235 students in 2011) prior to the BPI coming into effect for the Leaving Certificate examinations in 2012, to 31.5% in 2018 (16,837 students) after a steady increase in the intervening years (State Examinations Commission, 2018) (see Fig. 1). While comparisons with other education systems in relation to participation rates in upper secondary advanced mathematics studies are somewhat difficult due to various factors impinging on such participation and its calculation, Ireland appears to compare favourably.

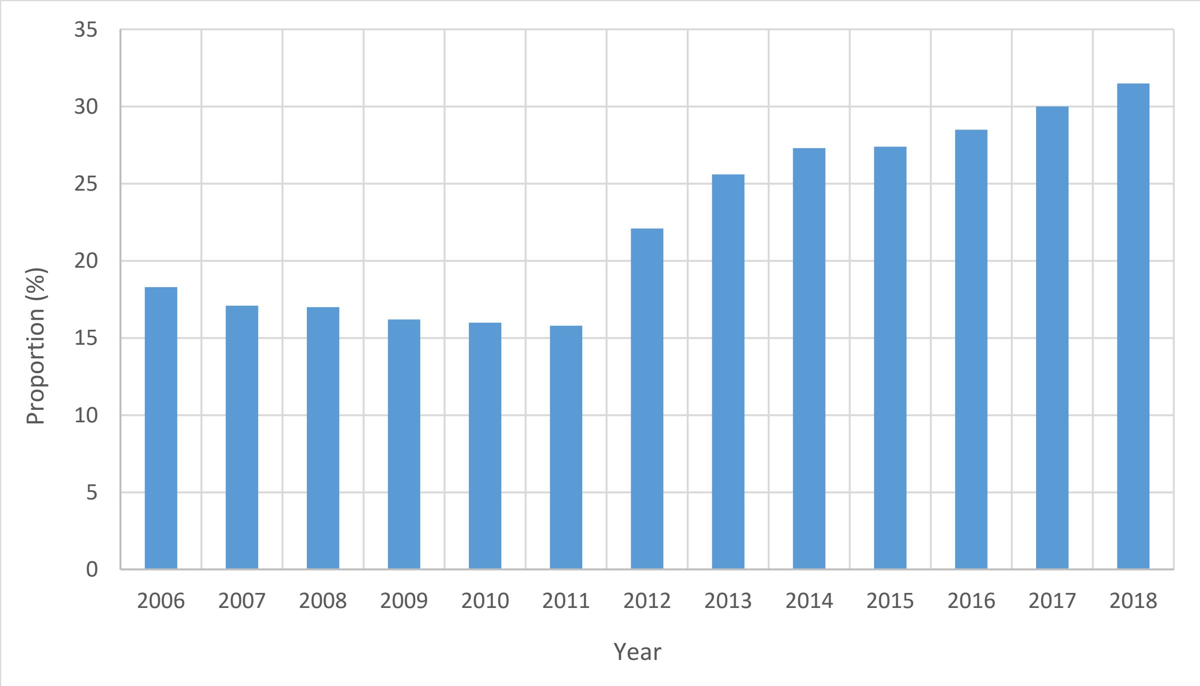

Figure 1: Proportion of students opting to attempt Higher Level Leaving Certificate mathematics examination from 2006 to 2018.

According to Hodgen et al. (2013), participation rates in upper secondary advanced mathematics studies at the time of that report would indicate that Ireland has moved ahead of the likes of England (13%), Germany (8-14%), Massachusetts (>16%), Hong Kong (22-23%), and Scotland (27%). Singapore and New Zealand led the way on 39% and 40% respectively. However, these proportions may have changed since the report was published and Hodgen et al. (2013) only listed a selection of regions, thus this is not an exhaustive list. Similarly, given that the proportions are calculated in relation to the number of students of upper secondary age who were in education, employment, or training at the time, these figures may not be a direct comparison with the proportion value of 31.5% attributed to Ireland. Having said that, this does provide some modicum of context against which to measure such participation rates.

Even though the proportion of students opting to complete the Higher Level Leaving Certificate mathematics examinations have gradually increased since 2012, some concerns have been raised. The Leaving Certificate Mathematics Chief Examiner's Report (State Examinations Commission, 2015) indicated that the substantial change in the number of candidates attempting the Higher Level examination due to the BPI may be causing some issues with grade distribution. According to the report, a greater proportion of students that would have typically attempted the Ordinary Level examination, were it not for the BPI, were attempting the Higher Level examination and thus there was an increase in those achieving low grades (State Examinations Commission, 2015). This report also highlighted the potential for this strata of students attempting the Higher Level examination to possibly fall short in mastering the higher-order thinking skills which were given an increased emphasis in the new curriculum. However, the report went on to indicate that, while these issues need to be considered, they may be at least in part attributable to the typical difficulties with transition to a new curriculum.

The aforementioned significant increase in the proportion of students opting to attempt the Higher Level Leaving Certificate mathematics examination was also analysed by Treacy (2018) to determine the potential effects of this change on the difficulty of the Higher Level Leaving Certificate mathematics examinations. Through this study, it was determined that it is likely that the difficulty of the Higher Level Leaving Certificate mathematics examination has decreased as a result of the BPI. The sharp increase in students attempting the examination along with the policy of maintaining a relatively consistent proportion of passing grades, often termed 'attainment-referencing', were highlighted as key factors leading to a perceived reduction in difficulty of the Higher Level Leaving Certificate mathematics examinations.

Theoretical Perspectives on Increasing Participation in Upper Secondary Advanced Mathematics

A focus on increasing the uptake of advanced mathematics study at upper secondary level would appear to be a worthwhile endeavour as research has established a relationship between attainment in mathematics and future earnings (Adkins and Noyes, 2016; Dolton and Vignoles, 2002) as well as building key skills for careers in areas such as quantitative social science (British Academy, 2015). Advanced mathematics study has also been linked with an impact on continued study and attainment within STEM subjects (Caprile, et al., 2015; Hoban, Finlayson, & Nolan, 2013) but this impact has not always been proven to be significant or conclusive (Adkins and Noyes, 2018).

Increasing motivation to study advanced mathematics at upper secondary level is clearly a key goal of the BPI. Intrinsic motivation – driven by interest as well as pleasure and satisfaction derived from a task – has been shown to have greater and more sustained impact on student performance in mathematics when compared to extrinsic motivation which is driven by external rewards (Murayama, Pekrun, Lichtenfeld, & Vom Hofe, 2013; Zhu and Leung, 2011). Such external rewards – bonus points would fit into this category – have been demonstrated to have an impact on student achievement but these tend to fade relatively quickly. In contrast, the development of a secure understanding of the fundamental concepts of mathematics through high quality, consistent instructional practices typically aids an increase in student enjoyment and perception of mathematics thus benefiting their intrinsic motivation to study the subject (Lepper, 1988; Middleton and Spanias, 1999). As such, introducing policies such as the BPI may have short term impact but it is questionable whether extrinsic motivation of this nature will achieve a long term impact on student motivation to engage effectively in advanced mathematics study.

Hodgen et al. (2013) explored education systems which have excelled in improving mathematics participation and achievement at upper secondary level, with New Zealand highlighted as a particularly good example. Their success in this respect seems to be built on providing students with greater choice through the provision of more than one high-status route for the study of mathematics. A key example of this was the option to study statistics alongside mathematical applications and fluency which is viewed as good preparation for those that intend to complete further studies in social sciences and life sciences. Options to complete individual units of study in mathematics are also available to students within that model. Policy makers in England seem to be adopting a similar approach with the introduction of Core Maths and other mathematics pathways in an attempt to increase and widen participation in post-16 mathematics (Hillman, 2014; Noyes, et al., 2011). Although still in its initial phase, this strategy appears to be aiding improvements in participation thus far (Smith, 2017).

Currently, Senior Cycle students in Ireland do not have many options for the study of mathematics beyond the level at which they study (Higher, Ordinary, and Foundation). While Applied Mathematics (similar to A-Level Mechanics in the UK) is offered as a subject which can be studied along with mathematics at Senior Cycle, the availability of this course of study is not widespread in schools in Ireland, resulting in only approximately 3.4% of students opting to complete the associated examinations each year (State Examinations Commission, 2018). The Higher Level Leaving Certificate mathematics examinations include no options either – students are expected to attempt all questions within the examination papers. Additionally, third level institutions have highlighted issues with the reduction in content within calculus and the removal of topics such as vectors and matrices upon the transition to the new Senior Cycle curriculum (Grannell, Barry, Cronin, Holland, & Hurley, 2011).

Presently, there are no indications that the BPI will be discontinued or altered in any manner. In fact, expansion of this initiative to other subjects is being considered. The

Department of Education and Skills (2017, p. 19) indicated in their 'STEM Education Policy Statement 2017-2026' that they will "[e]xplore the provision of bonus points in STEM-related Higher Level Leaving Certificate subjects (in cases where students apply for higher education courses in STEM-related areas)". This indicates that the BPI for mathematics is perceived to be a success by policy makers. Similarly, the significant increase in the proportion of students opting to study Higher Level mathematics for the Leaving Certificate examinations indicates, on the surface, that the BPI has been a success. However, the impact on day-to-day classroom practice of this significant increase in the proportion of students opting to study mathematics at Higher Level for Senior Cycle has not been clearly determined.

The experiences and perspectives of teachers in these classrooms need to be considered in any meaningful analysis of the impact of the BPI as they are the stakeholders that engage with the realities of policy change on a daily basis and can provide valuable perspectives (Bailey 2000). Changes in education policy imposed by state bodies, typically termed top-down reform (Fullan, 2012), lead to a range of intended and unintended outcomes (Fink, 2003). Better understanding of the experiences of those that engage regularly with the reality of such changes (e.g. teachers) is vital in order to fully understand the totality of the impact (Fink, 2003; Fullan, 2012). This paper will explore this impact and consider the significance of the issues raised.

Method

The aim of this study was to determine the effects, if any, of the BPI in Higher Level Senior Cycle mathematics classrooms from the perspective of teachers. The underpinning research question guiding this study was: How do upper secondary advanced mathematics teachers in Ireland perceive the impact on their day-to-day classroom experiences and practice of an incentive for students to study advanced mathematics? The main motivation for exploring this phenomenon was the recognition that the proportion of students in a given cohort opting to complete Higher Level Leaving Certificate mathematics examinations has almost doubled since the introduction of the BPI for the 2012 examinations. Scrutinising the potential impact on teachers of such a transformation is important for guiding policy of this nature in Ireland and internationally.

All data within this study (both qualitative and quantitative) were gathered through a questionnaire which was completed by 266 teachers of Higher Level Senior Cycle mathematics throughout Ireland. A questionnaire was selected as the primary research tool as it was important to gather responses from a large number of participants so that an informed understanding of the opinions of a nationally representative sample of upper secondary mathematics teachers could be distilled. Similarly, the anonymous nature of the questionnaire would encourage greater honesty thus potentially allowing for better reliability when compared to interviews (Cohen, Manion, & Morrison, 2007). As such, utilising a questionnaire was determined to be a more useful means of gathering data than conducting interviews.

This questionnaire was designed by the authors in consultation with an advisory group of five experienced secondary mathematics teachers and experienced academics in the field of mathematics education. This group assisted in refining the items on the questionnaire and providing initial insights into expected responses to each item during the pilot phase. The questionnaire comprised of seventeen items in total. The initial five items requested basic information about the respondent (e.g. number of years teaching) and the school at which they were currently teaching (e.g. number of students and school type). Subsequent items comprised of a mix of items within which the response expected was free text, multiple choice, or selection of an option from a 5-point Likert scale ranging from strongly disagree to strongly agree. These items were designed to gather information on school policies in relation to class groups studying mathematics at Higher Level for Senior Cycle; respondents' opinions of the BPI; perceived impact of the BPI on approaches to teaching; perceived impact of the BPI on student learning in mathematics; and other related issues.

The sampling frame for this study was the list of all 723 secondary schools in Ireland. Stratified random sampling was used to ensure questionnaires were sent out to a sample of 400 schools representative of the population. The key strata identified was type of school – secondary accounted for 51.5% of all schools, while the rest were designated as vocational (35.5%), community (11.1%), and comprehensive (1.9%)[1].

In April 2018, following internal ethical approval, the questionnaires were distributed via post to the Head of Mathematics at each school in the sample. It was requested in the accompanying information sheet that the two copies of the questionnaire enclosed should be completed by two teachers of Higher Level Senior Cycle mathematics in the school and returned using the enclosed stamped addressed envelopes. The aforementioned advisory group indicated that schools typically have two teachers that would be responsible for the teaching of Senior Cycle mathematics at Higher Level, hence the decision to request two completed questionnaires per school. 266 completed questionnaires were returned – a response rate of approximately 33%. While such a response rate for questionnaires is relatively good, the motivation behind a teacher's decision to respond needs to be considered. It may be the case that they were motivated due to the retention of strong opinions on the topic – this needs to be taken into account when considering the findings outlined.

The qualitative data for this paper was derived from responses to an item in the questionnaire which was worded as follows: "What impact (if any) has the Bonus Points Initiative had on your teaching of the Senior Cycle mathematics syllabus? Please elaborate." This paper will focus upon the thematic analysis of the responses to this question which were completed by 252 of the 266 respondents. Three other items from the questionnaire will also be referenced within the findings. Each of these three items requested the participants to respond to a statement using a five point Likert scale which ranged from 'Strongly Agree' to 'Strongly Disagree'.

Analysis of Qualitative Data

A 'bottom-up' content analysis of the qualitative data from the selected questionnaire item was carried out initially to form a rich understanding of the participants' experiences and opinions related to the changes which have taken place (if any) in their teaching of Higher Level Senior Cycle mathematics. This understanding was derived inductively through analysis, examination, and reflection on the relevant phenomena that were identified during repeated engagement with the data (Braun, Clarke, & Terry, 2014). The initial analysis was completed by the first author and reviewed by the other two authors. The qualitative data were coded using the computer program Maxqda Plus (version 2018) to determine the key features of the data. Upon completion of this initial phase, the authors drew upon Bailey's (2000) exploration of mandated educational change from teachers' perspectives to further inform the analysis of the data. This provided a lens through which to enhance understanding of the trends emerging as the analysis progressed.

Upon completion of the analysis, there was an identification of three key themes which will be discussed later in this article. Presentation of the data in the findings section to follow was constructed using these themes and informed by the analysis process described previously. Quantitative data, presented as descriptive statistics, were used to complement the rich understanding gained from the analysis of the qualitative data.

Findings

The data analysed within this study will be outlined according to the themes that were identified. Respondents will be referred to using the letter T and a number to differentiate each respondent.

Student attainment and progress – the new normal

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 was 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 whereby 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 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:

> 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.
>
> \- T140

> 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. 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, with 15.8% neutral. 23.8% either disagreed (18.1%) or strongly disagreed (5.7%) with the statement.

Effects on the Teacher and their Teaching Style

These changes in the make-up of Senior Cycle Higher Level class groups has, according to the data analysed, impacted upon teacher workload. 57 respondents (22.6%) specifically referenced the impact that the BPI has had on them through the need to provide extra classes or support; 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:

> 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.
>
> - T195

> A lot of students who most likely are not fit for [Higher Level] elect to try it for the [Leaving Certificate]. This has resulted in larger class sizes, a greater need for differentiated learning [and] completion of the course at a much slower pace. Very often, these students drop to [Ordinary Level], but they do so in the last couple of months after so much time has already been invested in helping them through [Higher Level].
>
> - T190

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:

> 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.
>
> - T139

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:

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

Otherwise, 5 responded positively (2%), indicating that the BPI has aided motivation of their students or that the increased ranges of abilities in their classrooms has challenged them to become better teachers.

Impact on Organisation and Structure

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:

> 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.
>
> \- T223

However, it is not clear whether or not this practice has begun as a result of increased Higher Level Senior Cycle mathematics cohort sizes. It may have always 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. Allied to this, some teachers indicated that there are more students that are unrealistic about their mathematical ‘ability’ or unwilling to take advice from the teacher to study at Ordinary Level rather than Higher Level. Such disruption appears to be adding further layers of difficulty to teachers’ classroom practice:

> I have begun the year with 30 students taking H.L. in 5th year, then they realise the commitment required and they have no where else to go as O.L. classes are full (we take

> up to 33 students) and I have ended up teaching higher AND ordinary level in the same class.
>
> - T103

A further item in the questionnaire alluded to teachers' beliefs that the presence of the BPI caused struggling students to persist. Participants were asked to respond to the following statement by choosing one of five options indicating their level of agreement or disagreement: 'Many students who are struggling at Higher Level persist due to the provision of Bonus Points'. 98.1% of the 265 respondents to this item either strongly agreed (74.8%) or agreed (23.3%) with this statement. Similarly, in responding to the statement: 'Students who drop from Higher to Ordinary Level are doing so later in Senior Cycle than was the case before the Bonus Points Initiative was introduced', 87.4% of the 263 respondents to this item either strongly agreed (43.7%) or agreed (43.7%).

Discussion

The findings above indicate that teachers are struggling to adapt to the 'new normal' with regards to ranges of attainment they are encountering in Higher Level Senior Cycle mathematics class groups that they teach. These groups, according to teachers who participated in this study, have a wider range of attainment when compared to previous Senior Cycle cohorts studying mathematics at Higher Level. Such a view of this attainment range would appear to be consistent with the findings of Treacy (2018) and the SEC (2015). Similarly, the level of motivation of some students to engage effectively with Higher Level Senior Cycle mathematics has been questioned. Due to this change, teachers need to adapt to accommodate this 'new normal' and ensure that all students make sufficient progress. As such, this shifts the typical challenges encountered by teachers when working with these class groups further towards 'mixed-attainment' teaching when compared to how these teachers would have typically taught corresponding cohorts before the BPI was introduced. However, it must be noted that these Senior Cycle Higher Level mathematics class groups are still obviously grouped by attainment due to their choice to study at this level. In any case, this observed change prompts the need to consider the challenges inherent in teaching class groups with broader ranges of attainment.

Grouping students according to attainment has typically been found to have little, if any, benefit overall to student outcomes when compared to mixed attainment groupings. Higher attaining students tend to make small gains, however, those placed in lower attaining groups have been reported to develop poor self-confidence and be more likely to have negative experiences in school (Archer et al., 2018; Boaler, Wiliam, & Brown, 2000; Boaler and Wiliam, 2001; Smyth, Dunne, Darmody, & McCoy, 2007). In contrast, typically average attaining and lower attaining students have been observed performing significantly better in mixed attainment class groups when compared to similar attainment class groups (Linchevski and Kutscher, 1998). However, there have been instances where grouping students according to prior attainment has been found to have positive effects on both higher and lower attaining students in terms of their achievements in mathematics and reading (Collins and Gan, 2013).

Despite evidence indicating that mixed attainment grouping may be more beneficial than attainment grouping practices, typical practice in schools continues to favour these attainment grouping practices (Hodgen, Foster, Marks, & Brown, 2018; Smyth, et al., 2007; Taylor et al., 2017). Taylor et al. (2017) examined the factors that deter secondary schools in England from adopting a mixed attainment approach, finding that there was a general reticence to engage in mixed attainment teaching as it was perceived to be quite difficult. This in turn resulted in few schools adopting such an approach, thus leading to few exemplars and resources for other schools to draw upon. With so few examples of a mixed attainment approach, there is little evidence within similar contexts that such an approach is beneficial which typically leaves key stakeholders sceptical about its merits. Taylor et al. (2017, p. 340) termed this as the "[v]icious circle of avoidance of mixed attainment grouping".

The causes for concern highlighted in Taylor et al.'s (2017) analysis of the factors deterring schools from adopting mixed attainment practices in the classroom are similar to those that were highlighted by the respondents in the findings above. Each of the following are common issues highlighted in both the findings outlined previously in this article and the findings from Taylor et al. (2017): the addition to workloads, the challenges of differentiating effectively, the worries that higher attaining students are neglected, the pressure to cover the syllabus, and the concerns with regards to pace of instruction.

Taylor et al. (2017) indicated that teachers adjusting to a wider range of attainment levels in the classroom require support through guidance and exemplars to aid the advancement of their practice. Similarly, the professional climate and associated policies need to support professional development and facilitate change rather than hinder it. These recommendations for supporting schools and teachers to adopt best practice with class groups which have wider ranges of student prior attainment are worth considering in the context of the changes which have occurred in the typical Higher Level Senior Cycle mathematics class group. Given that the typical Higher Level Senior Cycle mathematics class group has undergone a significant transformation since the introduction of BPI, teachers need to be supported in tackling the challenges which arise in such situations.

Guidance from literature on effective means of teaching mathematics in mixed attainment secondary school settings is sparse (Francis et al., 2017) but there are some studies which offer some relevant insights. Boaler et al. (2000) observed teaching of mixed attainment mathematics class groups in six UK schools and noted key differences in approaches by teachers of these groups when compared to the teaching of students in similar-attainment or 'set' class groups. Teachers of mixed attainment groups tended to differentiate by task and by outcome. Teachers differentiated by task when they challenged pupils in the same class to complete different work. They differentiated by outcome when they provided the same task to all but the task design allowed for a variety of ways in which it could be completed and/or a variety of challenge (Boaler, et al., 2000). They also observed that investigations, worksheets, and practical activities were common in lessons with mixed attainment class groups, whereas the focus was on 'chalk-board teaching' and textbooks in lessons with similar attainment class groups.

The TAP (Together and APart) project, implemented in Israeli Junior High Schools in order to facilitate mixed attainment teaching of mathematics, highlighted the need for teachers to implement grouping strategies in a responsive manner based on the needs of the students within the class group (Linchevski and Kutscher, 1998). Teachers of Higher Level Senior Cycle mathematics may benefit from guidance on how to perfect such modes of teaching in order to effectively adjust to the widening ranges of mathematical attainment they are encountering in their class groups.

Implementing the approaches espoused by Boaler et al. (2000) and Linchevski and Kutscher (1998) when teaching class groups of mixed attainment or, in the respondents' cases, widening attainment, requires guidance and support for teachers (Taylor, et al., 2017). The transition to the new curriculum for Senior Cycle was accompanied by professional development for all teachers in order to prepare them sufficiently to teach each of the five strands of the reformed syllabus. Ten one-day courses were provided over the course of five years, focussing on the means of delivery of the mathematical content along with the pedagogical practices which align with the aims of the new curriculum (Guerrero, 2014). These provisions to prepare teachers to deliver the content within the new curriculum were well received by teachers and deemed to be effectively implemented (Guerrero, 2014). However, it is questionable whether teachers were provided with similar support and guidance to deal with the impending transformation in their typical Higher Level Senior Cycle mathematics class groups. If significant changes such as the BPI are to be introduced into education systems, the resulting impact needs to be carefully considered and the relevant preparation in the form of professional development of teachers needs to be enacted.

Conclusion

Setting students in similar attainment groups is quite common, almost ubiquitous, in Senior Cycle mathematics in Ireland and, as such, teachers of these groups have been accustomed to a certain range of attainment within these class groups in the past. The BPI, according to our findings, significantly impacted the range of attainment in the typical Higher Level Senior Cycle mathematics class groups in a short space of time, thus presenting challenges to teachers which impacted their practice. Key factors highlighted included addition to workloads, the challenges of differentiating effectively, worries that higher attaining students are being neglected, pressure to cover the syllabus, and concerns with regards to pace of instruction. In order to facilitate teachers in developing their practice with class groups of wider attainment than to which they are accustomed, professional development with exemplars, resources, and support need to be put in place (Taylor, et al., 2017). While the requirement for enhanced support for one significant change in Secondary mathematics was recognised (i.e. professional development for curriculum change), it may have been the case that such support was not deemed necessary for the other significant change – the BPI. The presence of wider ranges of student attainment in the typical Senior Cycle mathematics classroom which coincided with the continued provision of the BPI is a challenge for teachers which must be recognised and addressed. It is likely that this was an unintended or unforeseen consequence which often occurs as a result of top-down reform (Fink, 2003).

While the BPI appears to have aided a significant increase in the proportion of students opting to study Higher Level mathematics for the Leaving Certificate examinations, the impact it has had on overall student attainment in mathematics upon completion of the Senior Cycle is questionable (Treacy, 2018). Similarly, teachers in this study regularly questioned the motivation and subsequent effort of some students as they believed them to be just 'hanging in' to achieve the bonus points. This would indicate that the extrinsic motivation to study advanced mathematics wrought by the BPI may be short lived. Taking into account the observed impact of extrinsic motivation on mathematics achievement in other studies (Murayama, et al., 2013; Zhu and Leung, 2011), this is somewhat expected.

Given the success of the New Zealand model (Hodgen et al. 2013), providing more choice for students at this level thereby promoting the study of advanced mathematics which is tailored to suit student needs may be a better route to improving mathematics participation and achievement in Ireland. However, with the proportion of students opting to study Higher Level mathematics for the Leaving Certificate examinations continuing to rise year on year, the full impact of the BPI and the means of adjustment by teachers, schools, and students is yet to be fully realised.

Notes

1. Schools in Ireland are given various different designations. Secondary schools are privately owned and managed while under the trusteeship of religious communities, boards of governors or individuals. Secondary schools typically receive a range of government grants and subsidies. Vocational schools and Community colleges are owned and run by local Education Training Boards. Vocational schools and Community colleges are managed by boards of management which typically comprise of parent, teacher, and community representatives. These schools are largely financed by the Department of Education and Skills. Comprehensive schools are managed by boards of management which typically comprise of parent, teacher, and community representatives. These schools are financed entirely by the Department of Education and Skills.

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