

Investigating the Time allocated to Teaching Mathematics in Irish Second Level Schools

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Abstract

The Irish Government introduced Project Maths in all schools nationally in September 2010 in what was a major reform of second-level mathematics education in Ireland. This reform involves a greater emphasis on problem solving and teaching for understanding. Research suggests that these new approaches, coupled with overly broad syllabi, are placing strains on the instructional time currently available for teaching mathematics. This instructional time differs between schools and indeed between classrooms within schools, with many teachers offering voluntary hours in an attempt to cover the course. In 2015 the authors received funding to carry out a major national study investigating the amount of time allocated to mathematics in Irish second-level schools. This paper outlines some preliminary results and findings which focus on whether the amount of time allocated to teaching mathematics in Ireland has changed since the introduction of Project Maths.

Background to the Research

The amount of time spent in formal instruction or teaching is an important measure of educational input (Department of Education and Skills [DES], 2013). A large body of literature exists which demonstrates strong, positive correlations between instructional time and student achievement. A consistent finding is that the amount of time students are actively and successfully engaged in essential academic skills contributes significantly to achievement (Harn, Thompson and Roberts, 2008). During the last three decades several highly publicised surveys of mathematics achievement (TIMSS, PISA) have further heightened public awareness about the presumed importance of mathematical knowledge and competencies. These studies have found a positive relationship between achievement and the number of hours, days, and year's students are formally required to take instruction in a subject (Smith, 2000). Increased instructional time facilitates greater exposure to knowledge and skill development and thus helps foster higher levels of achievement (Smith, 2000). Simply stated, student achievement increases when students are exposed to mathematics over longer time periods (Benavot and Amadi, 2004).

The Irish Context

Formal education in Ireland takes place in three stages, primary, second and third level. After completing their primary education, all students progress to the compulsory second level system which is typically of five or six years in duration

(there is an option of Transition Year which is a bridge between the Junior and Senior Cycle). Starting at the end of August and continuing until the end of May, the minimum length of the academic year is 167 days and schools are generally in operation for 6.75 hours per day (Beggy and O'Meara, 2014). The system is divided into two cycles, the Junior Cycle (lower second level) and the Senior Cycle (upper second level). The Junior Certificate is the state examination taken at the end of the third year of the Junior Cycle, when students are generally 15 years of age. There are twenty eight subjects in total to choose from for the Junior Cycle, but not all subjects are taken in every school and not all are formally assessed as part of the Junior Certificate examination. The amount of time that is allocated to each subject is not set out by the Department of Education and Skills except for CSPE and SPHE where every student must have one lesson of forty minutes per week. Despite this department curricula's suggest that ideally there should be 2.67 hours (4 forty minute classes) per week allocated for Irish classes, ideally 3.33 hours (5 forty minute classes) assigned to both English and Mathematics, 1.33 hours (a double forty minute class) for Physical Education and 2 hours (3 forty minute classes) for other compulsory subjects such as History, Geography, Natural Sciences and a Foreign language (Beggy and O'Meara, 2014, Eurydice Network, 2013). The remaining time is made up of Religious Education and other optional subjects which are offered at the schools discretion.

For the Leaving Certificate, Irish students generally choose between six and eight subjects from a possible thirty four which a school may offer. This is higher than their counterparts in other countries (NCCA, 2005; DES, 2010). The subject options include the compulsory subjects of Irish, English and Mathematics along with other optional subjects which the schools may offer. A consequence of the high number of subjects being taken by students is a lack of specialisation and the division of their time between many subjects. This has resulted in the amount of time allocated to any one subject at Senior Cycle being low by international comparisons (NCCA, 2005).

Time Allocated to Mathematics

The time allocated to mathematics in schools varies greatly all over the world. In Ireland the time generally spent on mathematics at primary level per annum (113 hours) is less than the OECD average of 134 hours (DES, 2010). The time recommended by the government for mathematics at second level (3.33 hours per week which is approximately 111 hours per annum) is similar to the OECD average (DES, 2010). This works out at 11.87% of the overall second level school time in Ireland being allocated to mathematics. While many countries in OECD PISA comparisons do not spend significantly more time on mathematics than Ireland, there are a number of associated concerns. First as mentioned previously, Irish students take a larger number of subjects in their terminal school examination than their counterparts in many other countries leading to a lack of specialisation and a greater division of school and independent study time (DES, 2010). Furthermore the time allocated to mathematics varies from

school to school as decisions relating to class times are made at school level. This means that the ethos of the school can determine the amount of mathematics that students experience throughout their second level education. Finally, all of these problems are exacerbated by the short length of the Irish school year (167 days) in comparative terms. Most other countries have longer school years. For example 180 days per year in the USA, 200 in Australia, 240 in Germany and Japan and 280 days per year in Singapore (O'Meara and O'Donoghue, 2011; OECD, 2004). Thus, despite the fact that the number of hours Ireland allocates to mathematics is relatively on par with the OECD average, the issue arises when we compare the number of subjects, variations between individual school allocations and the length of the school year.

Recent Reforms in Mathematics Education and its Impact on Time

Project Maths is a major reform of second level education in Ireland and was introduced to all schools nationally on a phased basis in September 2010. The overall aim of Project Maths is to teach mathematics in a way which leads to real understanding (DES, 2010). It involves changes to what students learn in mathematics, how they learn it and how they will be assessed. There is a much greater emphasis placed on students' understanding of mathematical concepts, with increased use of contexts and applications that will enable students to relate mathematics to their everyday experiences. Despite emerging evidence of the positive impacts on students' experiences of learning mathematics (Jeffes et al., 2013), many challenges remain for the implementation of the revised curriculum. It involves a new approach to mathematics which focuses on building understanding, rather than learning by rote. However this takes time (DES, 2010). The reform has prompted a number of reports and studies to suggest that there is an insufficient amount of time currently allocated to teaching mathematics in Ireland (DES, 2010; Cosgrove et al., 2012; Irish Mathematics Teachers Association (IMTA), 2012; Educational Research Centre (ERC), 2012; Jeffes et al., 2013; Beggy and O'Meara, 2014).

In a survey carried out by the ERC (2012), in which teachers were asked about the challenges that they perceived would hinder the successful implementation of Project Maths, time is the major challenge that teachers believed caused them most trouble when they are teaching the new syllabus. The teachers' responses to the survey indicated that they encountered considerable problems in relation to covering a course that they believe to be too long and too broad (Beggy and O'Meara, 2014). Similarly the IMTA (2012), Cosgrove et al. (2012) and Prendergast and Treacy (2015) found that the syllabus is seen as too long, with time becoming an issue due to the volume of the content. *'Time is a big thing, you have to just move on and there's so much to cover'*, *'The amount of material that has to be covered with the timeframe involved makes it very difficult'* (Teacher responses in Prendergast and Treacy, 2015). In addition to the long syllabus, reports also mention that the new approaches to teaching mathematics advocated by Project Maths, such as problem solving also take more time (IMTA, 2012, Cosgrove et al., 2012). There

is a need to introduce double periods for successful implementation of these new approaches. The IMTA (2012) outline that in order for meaningful learning to occur, longer periods than the generic 40 minute single classes are needed. Teachers have increased the attention they give to developing students' knowledge of the processes underpinning mathematics, placing a greater emphasis on teaching for understanding, and introducing students to a range of different methods to solve mathematical problems (Jeffes et al., 2013). This takes more time particularly when introducing new topics to ensure a basic understanding before moving on to more advanced concepts (Jeffes et al., 2013). Shortages of time such as those reported can inhibit teachers' willingness to involve students in mathematical problem solving and sense-making, particularly as the state examinations draw nearer and teachers feel increased pressure to cover the curriculum (Lubienski, 2011).

Methodology

The study carried out by the authors adopted a mixed method approach which combined both qualitative and quantitative methods of data collection. This study will focus on the questionnaire distributed to mathematics teachers. This was a comprehensive instrument which provided plentiful opportunity for teachers to offer their opinions on the time allocated to teaching mathematics in their schools. The sampling frame for this study was a list of all 723 post primary schools in Ireland (Dept. of Education website, February 2015). 11.1% of these schools are community schools, 35.5% are vocational schools, 1.9% are comprehensive schools and the remaining 51.5% are secondary schools. The targeted sample size was 1600 mathematics teachers. Using an estimate of four mathematics teachers in each school, a stratified random sample of 400 schools was selected. Four teacher questionnaires and four stamped addressed envelopes for the questionnaires to be returned in were sent to the 400 schools. Information sheets were also provided for all participants along with the questionnaire.

Upon receipt of the completed questionnaires the quantitative data was transcribed and saved into the computer programme SPSS. The open ended questionnaire responses were transcribed into a Microsoft Word document and analysed by identifying common themes which related to the research questions. The two main research questions that guided this paper were:

1. Has there been a change in the time allocated to mathematics at second level since the introduction of the new curriculum?
2. Have double periods been introduced at both Junior and Senior Cycle in order to allow for meaningful problem solving and teaching for conceptual understanding?

Findings and Results

Research Question 1

The authors first wanted to investigate if there has been a change in the time allocated to mathematics at second level since the introduction of the new curriculum.

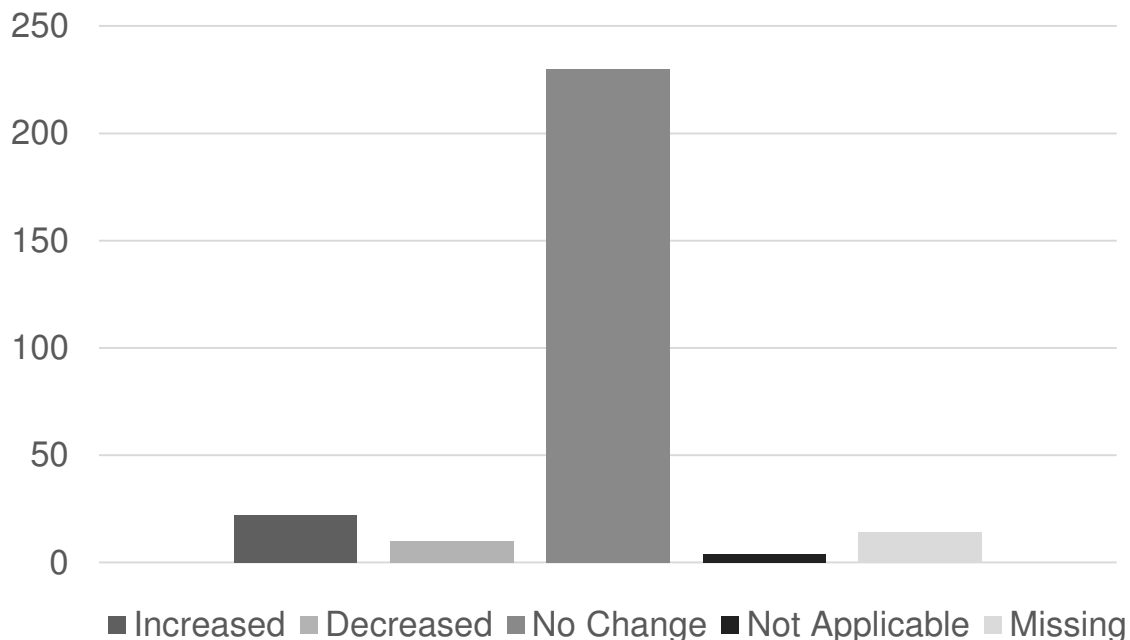


Figure 1: Since the introduction of Project Maths has the time allocated to mathematics at Junior Cycle changed?

Figure 1 shows that of the initial 262 teachers who responded to the first question, 87.79% stated that there was no change in the time allocated to mathematics at Junior Cycle since the introduction of Project Maths. A further 3.82% said that the time allocated had decreased, while 8.40% stated that there was an increase in the time allocated to mathematics. Since this study involved up to 4 teachers from each school, the authors carried out a cross tabular analysis to see how many schools from the study had changed their time allocation at Junior Cycle as a result of the introduction of Project Maths. This analysis highlighted that 12 of the 155 schools (7.74%) from whom responses were received had increased the time allocated to mathematics since the introduction of Project Maths, 4 of the 155 schools (2.58%) had witnessed a decrease while 144 of the 155 schools (89.67%) reported no change.

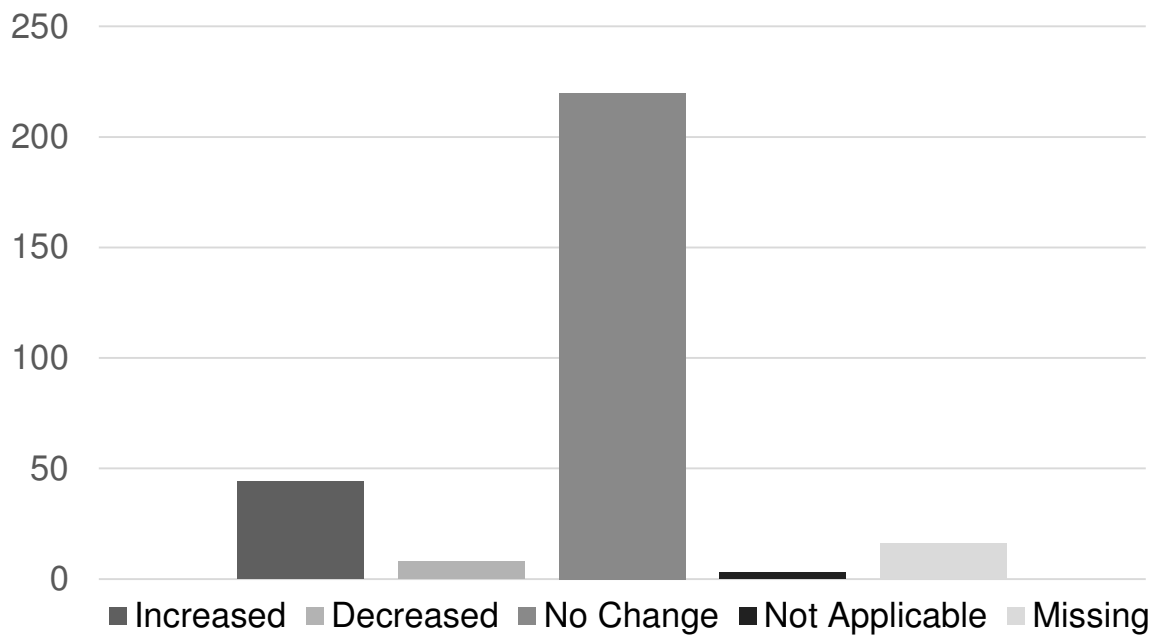


Figure 2: Since the introduction of Project Maths has the time allocated to mathematics at Senior Cycle changed?

There were 261 valid responses to the question inquiring about the change in time, or lack thereof, at Senior Cycle. Figure 2 shows that 16.86% of teachers said the time allocated to mathematics at Senior Cycle had increased, 3.07% of teachers reported a decrease while 80.08% found the time allocation remained the same. The cross tabular analysis showed that the 261 valid responses encompassed 149 secondary schools. The responses provided by teachers indicate that 24 of the 149 schools (16.10%) increased their time allocation at Senior Cycle, 6 of the 149 schools (4.03%) witnessed a reduction while teachers from 119 schools (79.87%) reported no change. While this is an improvement on the figures obtained for Junior Cycle many teachers still believe that further increases in time allocation are needed.

When asked to give a general comment on the time allocated to mathematics in their school some teachers brought up the fact that the introduction of Project Maths has not led to a change in the time allocated to mathematics despite the recognised change in content and emphasis.

T81: Time allocation remains unchanged in our school despite increased workload due to required changes in methodologies and need for greater understanding of material.

Furthermore teachers in schools that have made provisions for extra mathematics classes since the introduction still feel that further increases are needed.

T86: More time has been allocated however there is still a lot of time needed. There is pressure to get the course material covered and exam questions practised.

Research Question 2

The second research question was whether or not double periods had been introduced at both Junior and Senior Cycle in order to allow for meaningful problem solving and teaching for conceptual understanding. Figure 3 shows the responses from teachers in this survey.

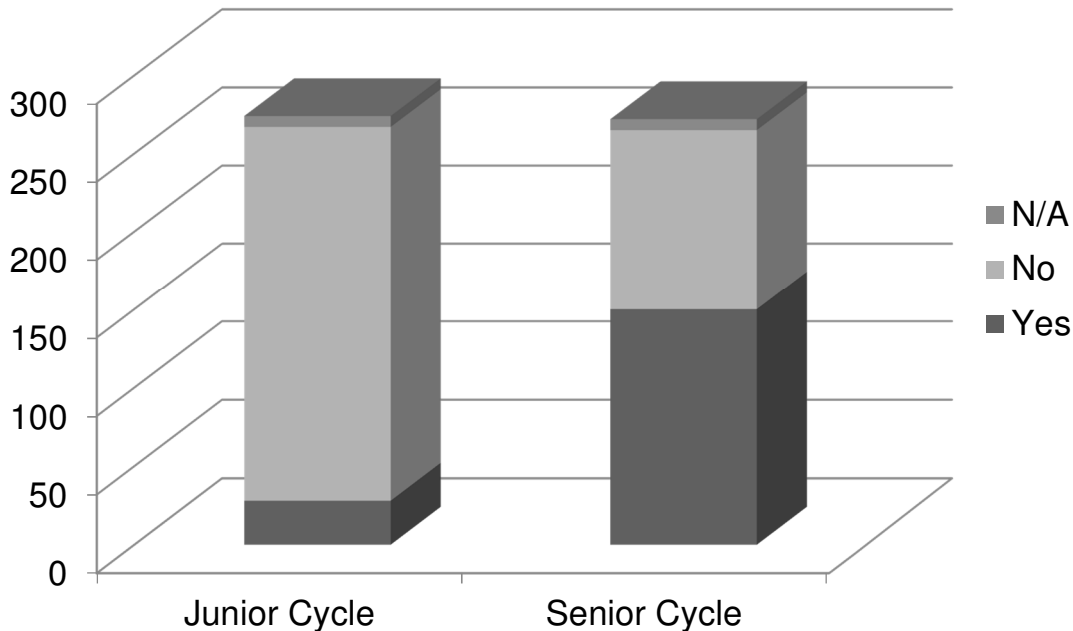


Figure 3: Do you have double periods in mathematics every week at Junior/Senior Cycle?

In total 274 teachers responded to the question that inquired about double periods at Junior Cycle with the question being applicable to 267 of them. 272 teachers responded to the question relating to Leaving Certificate with the question being applicable to 265. There was a significant difference between the responses received with only 10.29% of teachers reporting that they had a double mathematics period on a weekly basis at Junior Cycle. On the other hand 55.14% of teachers outlined that they had a double period of mathematics at senior cycle. The 267 teachers who responded to the question in relation to the Junior Cycle were based across 154 schools. The cross tabular analysis showed that 90.26% of schools ($n = 139$) did not provide double classes in mathematics for Junior Cycle students. On the other hand the 265 teachers who responded to the question in relation to the Senior Cycle taught in 148 schools nationwide and the cross tabular analysis showed that 58.11% ($n = 86$) did provide double mathematics classes for Senior Cycle students. The following qualitative responses obtained from the survey show teachers opinions in relation to double periods and in some cases the lack of double periods on the timetable:

T59: One double period would help especially in relation to “meaningful problem solving”, experiential learning.

T68: *There should be at least one double class, there isn't presently.*

T159: *The lack of double classes means it is almost impossible to address problem solving questions in any meaningful way.*

T175: *No double periods at Junior Cert. These would be very useful for problem solving. Understanding improves through investigation. Not enough investigation happening due to time constraints and trying to complete the course.*

Discussion and Conclusion

Research has indicated that the revised curriculum introduced in Ireland in September 2010 places extra time demands on teachers (Jeffes et al., 2013; IMTA, 2012). The new teaching methodologies, assessment methods and learning experiences being promoted by Project Maths are much more time consuming than the methodologies which teachers engaged with in the past (Cosgrave et al., 2012). However this study shows that the majority of schools surveyed reported no change in the time allocated to mathematics. While the findings for Senior Cycle are slightly more positive than those reported at Junior Cycle, there are still 80.08% of schools who have not changed the time allocated to mathematics since the introduction of the reform. The time allocation deemed appropriate to teach a syllabus in a procedural manner through the use of rote learning has not been changed to facilitate the shift to a constructivist approach to teaching, with greater emphasis on problem solving and conceptual understanding. This is illogical and teachers in this study voiced their opinions in this regard.

T101: *In order to teach for understanding at Senior Cycle, I don't feel that the time allocated is sufficient. With more time... there's much more resources that could be used in order to teach for understanding.*

Research has also pointed to the need to introduce double periods in order for the aims and objectives of Project Maths to be achieved (IMTA, 2012; Cosgrove et al., 2012). The IMTA state that at Junior Cycle students should have at least one double period and 4 single classes while at Senior Cycle they advocate 2 double periods and 3 single classes. O'Meara and Beggy (2014) also concluded that in order for effective mathematics teaching to take place nationwide double periods were needed. These double periods would allow teachers to engage their pupils in more meaningful problem solving activities and to teach for understanding. Teachers in this study concurred with the findings of previous researchers. They too felt that in order to meet the aims of Project Maths, double periods were necessary.

T210: *...no other 'practical' subject would work on single class periods. Incorporating the methodologies, pair work, group work approach to co-operative learning, it is very difficult to fulfil the requirements of the syllabus in single classes.*

Since all the evidence is pointing to the need for double periods to allow teachers to teach for understanding it is extremely worrying to see that 90.26% of schools involved in this study still do not offer double periods to Junior Certificate students. The work of Ni Riordáin and Hannigan (2009: 20) points to the need to “...ensure sufficient mathematical skills/concepts are developed at the early stages and to lay the foundation for further study in mathematics”. However this study demonstrates that in the early years of second level education when these important skills, concepts and mathematical foundations are introduced, teachers are not in a position to teach for understanding due to insufficient class time.

To conclude, this paper has shown that there is currently an inadequate amount of time allocated to mathematics in Ireland and classes in their current format are too short. This is having a negative impact on the teaching and learning of mathematics and in some cases it is even deterring qualified mathematics teachers from teaching mathematics to the highest level in secondary schools.

T17: This is a nightmare. I wrote to the board for extra time, I asked friends about timetable for maths in their schools. They get a double on one day of the week, we don't. Before project maths, my results at Leaving Cert were much better. There is not a chance I will opt to teach Higher Level. There is too much pressure from parents, inspectors and the media.

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