Routledge
Taylor & Francis Group

Journal of Curriculum Studies

ISSN: 0022-0272 (Print) 1366-5839 (Online) Journal homepage: http://www.tandfonline.com/loi/tcus20

Teaching mathematics after hours

Niamh O'Meara & Mark Prendergast

To cite this article: Niamh O'Meara & Mark Prendergast (2018): Teaching mathematics after hours, Journal of Curriculum Studies, DOI: 10.1080/00220272.2018.1535666

To link to this article: https://doi.org/10.1080/00220272.2018.1535666

JOURNAL OF CURRICULUM STUDIES
https://doi.org/10.1080/00220272.2018.1535666

Routledge
Taylor & Francis Group

Teaching mathematics after hours

Niamh O'Meara [a] and Mark Prendergast [b]

[a]EPISTEM, School of Education, University of Limerick, Limerick, Ireland; [b]School of Education, Trinity College Dublin, Dublin, Ireland

ABSTRACT

The quantum of instruction time allocated to curriculum subjects such as mathematics facilitates greater exposure to knowledge and skill development, leading to higher levels of achievement. There are a number of manifestations of time to consider when investigating the quantum of time in mathematics education. The OECD have investigated the time allocated to mathematics by schools internationally, while also reporting on the prevalence of private tuition and time spent on homework. However, to date, no attention has been afforded to the provision of 'hidden curriculum time' for mathematics. This study seeks to advance the work of the OECD and describes a case study that sought to ascertain if teachers in Ireland provide additional mathematics lessons outside of school hours. The authors examined how prevalent this practice is, how many additional minutes some students receive as a result of this practice and ascertained teachers' reasons for providing/not providing these additional mathematics classes. The results from this case study show that the majority of teachers at Senior Cycle provide these classes while a large proportion of Junior Cycle teachers also do. In extreme cases, these additional classes expose students to an additional 88.3 h of mathematics over the two-year Senior Cycle programme.

KEYWORDS

Inequity; mathematics education; mathematics instruction time; hidden curriculum

Introduction

A large body of literature demonstrates strong, positive correlations between instruction time and student achievement (Benavot & Amadi, 2004). The work of Carroll (1989) indicates that academic achievement is dependent on variables representing the amount of time available to learn, the time needed to learn and the time a student is willing to spend learning. Research shows that the more time students are engaged in learning, on average, the higher their grades (Clark & Linn, 2003; Harn, Thompson, & Roberts, 2008). However, any study that seeks to investigate the quantum of time must consider four manifestations of time, namely scheduled in-class time; out of class 'hidden' time; homework time and time spent in private tuition. This was the theoretical underpinning of this study, as depicted in Figure 1. Internationally, many studies have investigated scheduled in class time, homework time and time spent in private tuition (OECD, 2014; Eurydice Network, 2014; Prendergast & O'Meara, 2016b) and some findings from these studies are presented in this article. The motivation for this study came from the desire to build on these international studies by conducting a large-scale case study into the quantum of time allocated to mathematics in Ireland and this article reports on one aspect of this investigation, namely the 'hidden' curriculum time. More specifically, in the past it has been reported internationally that the amount of instruction time allocated to a certain curricular area varies enormously between schools and even

CONTACT Niamh O'Meara Niamh.omeara@ul.ie EPI*STEM, A1-064, University of Limerick, Limerick, Ireland

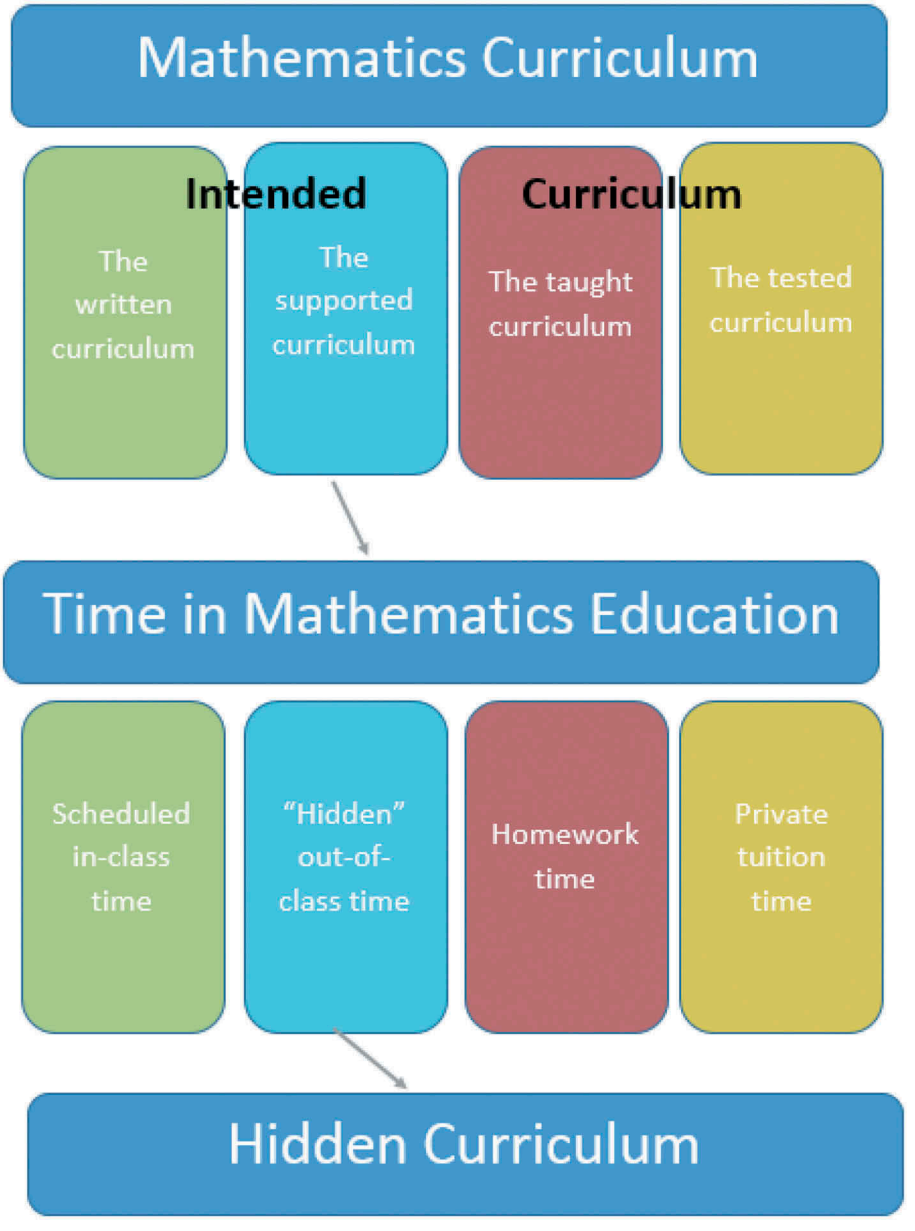

Figure 1. Conceptual framework.

between year groups (Anderson, 1981; Karweit, 1984). Similar findings have been reported more recently in Ireland (Prendergast & O'Meara, 2016c) and so this study also sought to investigate one strategy that could be employed by teachers to counteract this inequity, namely the provision of voluntary classes outside of the school day. While this was one of the first studies that thoroughly investigated the phenomenon of voluntary classes the authors firmly believe that it is not an issue confined to the island of Ireland and this 'stop-gap' measure ought to be investigated internationally.

Research on teaching time and more specifically 'allocated teaching time' has a long history dating back to at least 1963 when Carroll (1963) published his seminal work. Much of this research

has focussed on how time is used in mathematics classrooms and the link between how time is used and student attainment (Anderson, 1981; Karweit, 1984). However, this study is different in that it focuses more on the time allocated to mathematics as opposed to how that time is used thus building on the work of Wiley and Harnischfeger (1974). It considers a dimension of time which is rarely considered when investigating time allocated to curricular subjects. Furthermore, time spent teaching mathematics outside of class time is not considered as part of the definition of allocated time (Cotton & Wikelund, 1990) but rather considered 'hidden curriculum time' and as such very little research has been conducted in this particular area internationally. This gap in the literature combined with the concerns reported internationally about the variation in time assigned to mathematics and the measures in place to counteract this problem led the authors to conduct a case study into the 'hidden time' allocated to mathematics in an Irish setting. In conducting this case study, the authors add a new dimension to the time quantum which is of relevance to education settings worldwide and addresses an issue relating to the hidden curriculum.

Existing findings on the quantum of time allocated to mathematics

The Eurydice Network (2014b), the OECD (2014) and Prendergast and O'Meara (2016a, 2016c)) all investigated the in-class time allocated to teaching mathematics in schools globally. They found that at post-primary level, an average of 12% of instruction time is allocated to mathematics across OECD countries. However, this ranges from 11% in Greece and Korea, to 16% in Chile and 20% in Italy (OECD, 2014). In Ireland, the time recommended by the Department of Education and Skills [DES] for mathematics at post-primary level is 3.33 h per week, which is approximately 111 h per annum (DES, 2010). This works out at 11.87% of the overall post-primary level time in Ireland being allocated to mathematics, which is similar to the OECD average. Despite the existence of such guidelines, Irish post-primary schools are still free to decide how much instruction time to allocate to each subject (Eurydice Network, 2014b). This is similar to the situation in both the UK, France and the Netherlands. Such policy results in variations between the time allocated to teaching mathematics in different schools and between different class groups within the same school. This was confirmed in the work of Prendergast and O'Meara (2016c) who found that a substantial inequity exists in relation to the time allocated to mathematics in Irish secondary schools. Their work found that 'Depending on the school they attend, the year group they are in and the level of mathematics they study, students can expect to receive different amount of instruction time [in mathematics]' (Prendergast & O'Meara, 2016c, p.20). Likewise this has been an issue reported internationally with Phelps, Corey, DeMonte, Harrison, and Loewenberg Ball (2012) and Gaines (2012) stating that the time allocated to mathematics can vary depending on school, district, classroom, state or country. Furthermore, Fowler and Poetter (2004) found this to be the case in France, as teachers did not adhere to the guidelines proposed in relation to the time that ought to be allocated to each subject. Essentially, this means that the ethos of the school and the individual opinions of school management or teachers can determine the amount of mathematics that students experience throughout their post-primary education (Prendergast & O'Meara, 2016b) and in turn can affect students' success in and experiences of the subject.

Such issues regarding instruction time have resulted in a number of reports determining that the in-class time allocated to teaching mathematics at post-primary level is insufficient in some schools internationally (Cosgrove, Perkins, Shiel, Fish, & McGuinness, 2012; Fowler & Poetter, 2004; Irish Mathematics Teachers Association [IMTA], 2012) and a large number of teachers are unhappy with the current allocation of time (IMTA, 2012). Teachers internationally have claimed that they have insufficient time to teach mathematics (Fowler & Poetter, 2004) and to combat this inequity and teachers' levels of unhappiness with the time allocated to mathematics, anecdotal evidence suggests that there are a high number of teachers offering voluntary, additional mathematics classes outside of school hours in an attempt to teach the full mathematics curriculum. However, there is a dearth of research into this phenomenon. As such, this case study aims to quantify this

problem and determine the proportion of teachers offering additional classes in the Irish education system. The authors also discuss whether this is helping to solve issues of inequity in relation to time, or instead, if it is serving to exacerbate the problem. Such findings would help to inform international practice.

Time allocated to mathematics outside of in-class time

As mentioned previously, in order to augment in-class time teachers and students use the time available to them outside of the mathematics class to do extra work relating to the mathematics curriculum. This out-of-class time manifests itself in three different formats:

(a) Homework time
(b) Time spent in private tuition
(c) Voluntary mathematics classes

Some of these dimensions have already been investigated from an international perspective. In 2011, the OECD investigated the issue of student learning time in 57 countries (30 OECD countries and 27 partner countries) across three different subjects (mathematics, science and the language of instruction). Their findings were based on the responses submitted by 400,000 students during the PISA 2006 survey. They analysed the time allocated to mathematics under three main headings, namely regular lessons in mathematics, out-of-school-time lessons in mathematics and independent learning in mathematics. Their findings indicate that, in a number of different countries, a sizeable number of students attend out-of-school lessons in mathematics. They approximated that, on average, across OECD countries, 48% of students surveyed attended some form of tuition outside of school time but it was not clear from their findings whether these were provided by tutors (private tuition), or teachers on a voluntary basis.

Since 2006, many revised mathematics curricula have been introduced in a number of different countries worldwide, and in 2013, the OECD conducted a similar analysis to that conducted by PISA in 2006. This study was based on the responses of 510,000 who completed the PISA survey in 2012. This would allow one to see any changes that took place since the introduction of revised curricula. In this report, it was cited that, on average, 62.1% of students across OECD countries attended out-of-school lessons in mathematics, an increase of 14% over the six-year period. More pertinent to this study were the findings reported regarding the provision of extra mathematics lesson by schools outside of scheduled class time. On average, across all countries surveyed, 37.9% of students said that such classes were available to them (OECD, 2013). However, this figure was significantly higher in countries such as Japan, Shanghai—China and Vietnam where 69.8%, 70.7% and 82.8% of students, respectively, stated that they attended such classes. Contrary to this, the percentages reported for countries such as Ireland, Norway and Liechtenstein (24.1%, 22.7% and 26.1%, respectively) were lower than the OECD average (OECD, 2013).

In addition to looking at the prevalence of out-of-school lessons in mathematics, both OECD (2011) and OECD (2013) look at the reasons why these additional classes were provided. According to OECD (2011, p. 46) 'Out-of-school-time lessons given by school teachers are often organized for remedial purposes, to help underperforming students keep up with the rest of the class'. This was somewhat in contrast to OECD (2013) which presented findings from a principal survey in which participants were asked for the reasons their school provided out-of-school-time mathematics lessons. On average, across OECD countries, 32.5% of principals stated that these classes were provided for remedial purposes. The majority (53.7%) stated that the classes were to allow for both remedial and enrichment mathematics while a further 6.5% stated that they were for enrichment purposes only. The findings from an Irish perspective were similar to the OECD average. 34% of Irish principals reported that the classes were for remedial purposes, 18.8% said the classes were for

enrichment purposes while 45.5% said that the classes allowed for both enrichment and remedial mathematics.

In addition to the out-of-school time discussed above, which may or may not be on a voluntary basis, homework and private tuition are often seen as alternative options to compensate for the perceived lack of in-class time. There has been much debate in recent years regarding the advantages and disadvantages of homework and research has yielded mixed results. In the UK, Farrow, Tymms, and Henderson (1999) found that students who completed homework once a month in the core areas of mathematics, English and science had higher test scores than those who reported doing homework more frequently. On the other hand, Cooper, Robinson, and Patall (2006) conducted a similar study in the USA and cast a shadow over these findings as they note that the relationship between the amount of homework students do and their achievement outcomes was positive and statistically significant. In Ireland, there are no national guidelines for schools about homework but individual schools are recommended to have a policy on the matter (Jackson & Harbison, 2014). Without any steadfast guidelines on the time allocated to homework, it is unsurprising that the time assigned to homework is another aspect of curriculum time that appears to vary between countries. In 2012, the average amount of time spent on homework across OECD countries was 4.9 h per week (OECD, 2014). Students in Shanghai reported that they spend on average 14 h per week on homework while students in Ireland, Italy and Russia reported spending in excess of 7 h per week on homework. In contrast, Finnish and Korean students reported spending less than three hours per week engaged with homework (OECD, 2014). In addition to the additional time spent completing homework Chinese students, who consistently score in the top band in mathematics international comparison tests (OECD, 2014a), do hours of extra study at home and in private after-school tuition (Ferreras & Olson, 2010). The Irish Mathematics Teachers Association [IMTA] (2007) also investigated this issue of private tuition in an Irish context. They found that 27% of Irish students partook in private tuition outside of school time but this tuition was found to have no significant impact on grades obtained in state examinations. On the other hand, an OECD report in 2010 found that children in Shanghai, that is, children who consistently perform above the OECD average in international comparison tests, were extremely likely to attend after school tutorial groups. They stated that four out of five Shanghai children attended such groups in the evenings and at weekends.

In summary, international research now exists which provides an overview of the time allocated to mathematics during the school day, the time allocated to homework across a range of countries and the proportion of children who attend private tuition outside of school time (OECD, 2014, 2011; Prendergast & O'Meara, 2016a). Each of these findings have shown there to be significant variations across each of these manifestations of time. Despite the quantum of time being analysed under these three headings there are still numerous reports which have suggested that there remains a lack of time allocated to the subject (Cosgrove et al., 2012; IMTA 2012). This combined with the recent introduction of a revised post-primary mathematics curricula in Ireland and the gap in the research in relation to the 'hidden' time provided by teachers on a voluntary basis, have resulted in anecdotal evidence suggesting there has been an increase in the provision of voluntary classes outside of the school day. This was the research hypothesis that underpinned the study and from this, the following three research questions evolved for this particular case study:

- What proportion of teachers provides additional, voluntary mathematics classes to post primary students outside of school time?
- How much extra time is afforded to students during these classes?
- What are the main reasons cited by teachers for providing or not providing additional mathematics classes outside of school time?

Conceptual framework

The conceptual framework that underpinned this study was the school mathematics curriculum. The definition for the curriculum offered by the National Council for Teachers of Mathematics [NCTM] along with the framework for the intended and hidden curriculum, presented by Glatthorn, Boschee, Whitehead, and Boschee (2012), were the foundations upon which the author's conceptual framework was built. This is depicted in Figure 1.

According to the National Council for Teachers of Mathematics [NCTM] (1989, p. 1)

'A curriculum is an operational plan for instruction that details what mathematics students need to know, how students are to achieve the identified curricular goals, what teachers are to do to help students develop their mathematical knowledge, and the context in which teaching and learning occurs.'

The context in which teaching occurs details operational conditions that allow for effective teaching and learning. A significant element of these operational conditions is the time available for each subject and how subjects are timetabled. As such time is deemed to be a key component of the NCTM's definition of curriculum and is central to its effective delivery. In fact, the authors' ascertain that time transcends the curriculum. This was further emphasized in the work of Glatthorn et al. (2012) who recognized four pillars that underpinned the intended curriculum. They labeled these pillars as the written curriculum; the supported curriculum; the taught curriculum and the tested curriculum. According to the work of Glatthorn et al. (2012, p. 12):

'The supported curriculum is the curriculum as reflected in and shaped by the resources allocated to support, and deliver it. Four kinds of resources seem to be most critical here: the time allocated to a given subject at a particular level of schooling (How much time should we allocate to social studies in Grade 5?); the time allocated by the classroom teacher within that overall subject allocation to particular aspects of the curriculum (How much time shall I allocate to the first unit on the explorers?); personnel allocations as reflected in and resulting from class-size decisions (How many physical education teachers do we need in the middle school if we let PE classes increase to an average of 35?); and the textbooks and other learning materials provided for use in the classroom (Can we get by with those old basals for one more year?).'

While Glatthorn et al. (2012) specifically state that four resources are central to the supported curriculum, time is cited in two of the four outlined. This again indicates that time is a significant factor in any curriculum framework, hence why the theoretical framework for this study was shaped by the mathematics curriculum.

With a conceptual framework established the authors then sought to conceptualize the notion of time. In order to conceptualize time the authors held discussions with qualified mathematics teachers with between 8 and 15 years experience to determine what they believed to be the key components of the quantum of time to implement the curriculum. These discussions led the authors to identify four different manifestations of time that were critical when analysing the quantum of time allocated to a school subject, in this case mathematics. The four dimensions identified by the authors in conjunction with teachers, as shown in Figure 1, were in-class assigned time; 'hidden' out-of-class time; homework time and time spent in tuition. In-class time refers to the time assigned to mathematics by a school over the course of a day/week/academic year. This was also identified as a key manifestation of time in the work of Cotton and Wikelund (1990). Homework time refers to the time spent on homework by students while time spent in tuition refers to the time students' allocate to mathematics when they engage in private mathematics classes run by bodies external to the school, which the students are required to pay for. These were both identified as key critical dimensions of time allocated to a subject by OECD (2014). To date, many studies have investigated scheduled in-class time, homework time and time spent in private tuition (Prendergast & O'Meara, 2016a; 2016b; Eurydice Network, 2014a; OECD, 2014) but very little research has been conducted into the fourth dimension identified.

'Hidden' out-of-class time refers to the time that students spend engaged in mathematics lessons on a voluntary basis outside of the designated school day. In general teachers, on a voluntary basis, provide these classes and students voluntarily attend. As such, this time is considered 'hidden time' and so is a key component of the second type of curriculum that Glatthorn et al. (2012) discuss—the hidden curriculum (see Figure 1). This gap in the literature, combined with the concerns reported internationally about the time assigned to mathematics, led the authors to conduct a case study into the 'hidden curriculum time' allocated to mathematics in an Irish setting. In conducting this case study the authors add a new dimension to the time quantum and address an issue relating to the hidden curriculum.

Methodology

To address these research questions a mixed method approach was adopted. Such an approach combines both qualitative and quantitative methods of data collection. It was important to get a high response rate and the authors felt that the response rate would be increased if they used a research tool that would be easy to distribute and collect and one that the participants did not find too time consuming to complete. As a result, a four-page questionnaire was designed for the purpose of this study and was distributed by post to post-primary mathematics teachers. The questionnaires were designed with the help of a Teacher Research Advisory Group (TRAG), which consisted of four teachers. The teachers involved in this group were experienced in their positions and were recruited using a purposive sampling method (each teacher was known in a professional capacity by at least one of the researchers).

The teachers in the advisory group were not research subjects and as such did not complete the questionnaire. Rather they were invited to participate on the basis of the expertise they could bring to the research and the contemporary experiences they have in similar peer groups to the research participants (Murphy, Lundy, Emerson, & Kerr, 2013). Their remit was to assist the authors in identifying the different manifestations of time that were critical when analysing the quantum of time; advise on the development and distribution of the questionnaires and to provide a key stakeholder perspective to any of the issues raised by the research. There were two meetings held with the TRAG. Prior to the first meeting the authors had conducted an extensive literature review investigating the time allocated to mathematics both in Ireland and internationally and had developed a conceptual framework that would underpin the study. This enabled the authors to identify various issues associated with time allocation and these issues were discussed with teachers during the first meeting. The issues included the key manifestations of time; the differences between allocated time and time spent teaching mathematics and the key concerns they had in relation to the time allocated to mathematics in Ireland. Following this discussion, a structure for the teacher questionnaire was put in place and key areas for investigation were decided upon. The second meeting of the TRAG involved the piloting of the research instrument with the four teachers who were members of the TRAG. They advised that the questionnaire be kept short (maximum of four pages); that in the question regarding classes outside of school time the word voluntary be underlined so as to emphasize the fact that we are only focussing on classes that are provided free of charge and that teachers who did not provide voluntary classes should also be given the opportunity to provide some qualitative feedback in relation to the reasons why they did not provide such classes. This opportunity was provided through the inclusion of an open-ended question in the final research instrument which asked teachers to outline the reasons why they did or did not provide voluntary classes. Finally, the TRAG also gave the authors some advice in relation to the selection of participants for the study. They advised that, on average, there are four qualified mathematics teachers in each Irish post-primary school.

The questionnaire consisted of four sections. Section A looked at the time allocated to mathematics, the provision of double periods and teachers opinions in relation to the time allocation. Section B investigated the provision of voluntary classes outside of school time and the reasons

behind teachers offering, or not offering, such classes. Section C examined the number of classes foregone due to extracurricular activities and Section D explored the time allocated to mathematics homework across different year groups. Table 1 shows the different types of questions that were asked in each of the four sections.

This article focus specifically on the section of the questionnaire which investigated the provision of voluntary classes outside of school time (Section B). In this section the term voluntary classes was defined for teachers as *classes which are not scheduled in the school timetable but that you provide for students in your own free time without charge*. The questions relevant to this particular manuscript were sub-questions of question B1, B2, B3, B4 and B5. Examples of some of the relevant questions are:

B1—Sub-question 2—*Do you provide voluntary classes outside of school hours on a weekly basis to Junior Cycle Higher Level Students?* (Dichotomous)

B3—Sub-question 2—*If you provide voluntary classes outside of school hours to Senior Cycle Ordinary Level students when do these commence?* (Dichotomous)

B4—Sub Question 4—*How many extra classes do you give per week to Senior Cyle Higher Level students? How many extra minutes per week does this equation to?* (open-ended numerical values)

B5—Sub Question 1—*Can you outline, if applicable, why you do or do not provide additional, voluntary classes to Junior Cycle Students?*

The sampling frame for the study was a list of all 723 post primary schools in Ireland (DES website, February 2015). Around 11.1% of these schools are community schools, 35% are vocational schools, 1.9% are comprehensive schools and the remaining 52% are secondary schools. These school types were the four strata used when selecting the sample. The targeted sample size was 1600 teachers. A stratified random sample of 400 schools was selected: 44 schools (11.1%) were community schools; 140 (35%) were vocational schools; 8 schools (1.9%) were comprehensive schools and 208 (52%) were secondary schools.[1] Four teachers in each of the 400 schools selected were sent a questionnaire to be completed and returned in a stamped addressed envelope. This was based on the advice received from the TRAG. Information sheets were also provided for all participants along with each questionnaire. These information sheets outlined the background and aims of the study along with instructions on the completion and return of the questionnaires. The letters also detailed how teachers were under no obligation to complete the questionnaires but completion and return of the questionnaire implied consent. All stamped addressed envelopes were also given a number corresponding to the school selected so the researchers could identify the schools that had returned the completed questionnaires. Two weeks after sending the questionnaires, follow-up telephone calls to each of the schools that had not returned any questionnaires were undertaken so as to increase the response rate. Around 33.75% (540) of the 1600 teachers in the sample responded to the survey, a response rate higher than the 20%–30% which

Table 1. Questionnaire design.

	Question	No. of Sub Questions	Paradigm	Type of Question
Section A	A1	12	Quantitative	5-point Likert Scale (1—Strongly Disagree, 5—Strongly Agree)
	A2	2	Quantitative	5-point Likert Scale (1—Strongly Disagree, 5—Strongly Agree)
	A3	5	Quantitative	Dichotomous (Yes/No)
	A4	3	Quantitative	Multiple Choice (3 options)
	A5	2	Qualitative	Open ended
Section B	B1	4	Quantitative	Dichotomous (Yes/No)
	B2	2	Quantitative	Multiple Choice (4 options)
	B3	2	Quantitative	Multiple Choice (3 options)
	B4	4	Quantitative	Open ended with numerical values
	B5	2	Qualitative	Open ended
Section C	C1	6	Quantitative	Open ended with numerical values
Section D	D1	6	Quantitative	Open ended with numerical values

Table 2. Type of school of mathematics teachers who responded.

	Secondary	Vocational	Community	Comprehe-nsive
National Figures	52%	35%	11%	2%
Mathematics teachers	57%	31%	10%	2%

was recommended by Veal and Flinders (2001) for mailed surveys. The responses received were distributed across the four school types in a manner similar to the national distribution (Table 2).

The quantitative data was recorded, summarized and analysed using the computer package SPSS. The open-ended questionnaire responses were transcribed and analysed using NVivo. This data was then analysed using a 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 questions, 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. Each of the authors worked separately on the data, to derive their own codes. The coding allocated by each researcher was then compared and any discrepancies were discussed and resolved by the authors before the coding scheme was finalized.

Results

In order to address the first research question, teachers were asked if they provided voluntary classes, in their own free time, outside of the school day, on a **weekly** basis throughout the school year. The responses to this question are provided in Table 3.

From Table 3 it is evident that the provision of voluntary classes in Ireland is common practice among a substantial number of teachers. The majority of teachers at both Junior Cycle and Senior Cycle higher level offer additional classes to their students on a weekly basis throughout the academic year while almost half the teachers who teach Senior Cycle ordinary level offer these classes. It is only the majority of teachers at Junior Cycle, ordinary level, who reported not providing these classes on a weekly basis. This means that a vast number of students in Irish schools are allocated additional time in mathematics on a weekly basis on top of the time already assigned to the subject during the school day. In addition to the large number of teachers who provide additional class time on a weekly basis, other teachers of higher level students reported providing additional mathematics classes on an ad hoc basis at different times in the school year. For example, 24 of the 463 teachers (5.2%) who taught Junior Cycle higher level mathematics stated that while they did not give weekly classes throughout the school year they did provide voluntary mathematics classes at certain times in the school years. For example:

> T8: I do it at the end of the year if needed to finish or revise the course. They [students] will always come.
>
> T133: …majority of revision has to be done in block classes times outside of school hours at weekends or holiday times.
>
> T155: I provide additional classes to Junior Cert students during Easter break. It is mostly as a response to panic for mock exams and I give a day during the holidays for students to come in and ask/do questions.

Table 3. Prevalence of mathematics classes outside of school hours on a weekly basis.

	N	Yes	No
Junior Cycle Ordinary Level	418	96 (23%)	322 (77%)
Junior Cycle Higher Level	463	254 (55%)	209 (45%)
Senior Cycle Ordinary Level	440	216 (49%)	224 (51%)
Senior Cycle Higher Level	388	267 (69%)	121 (31%)

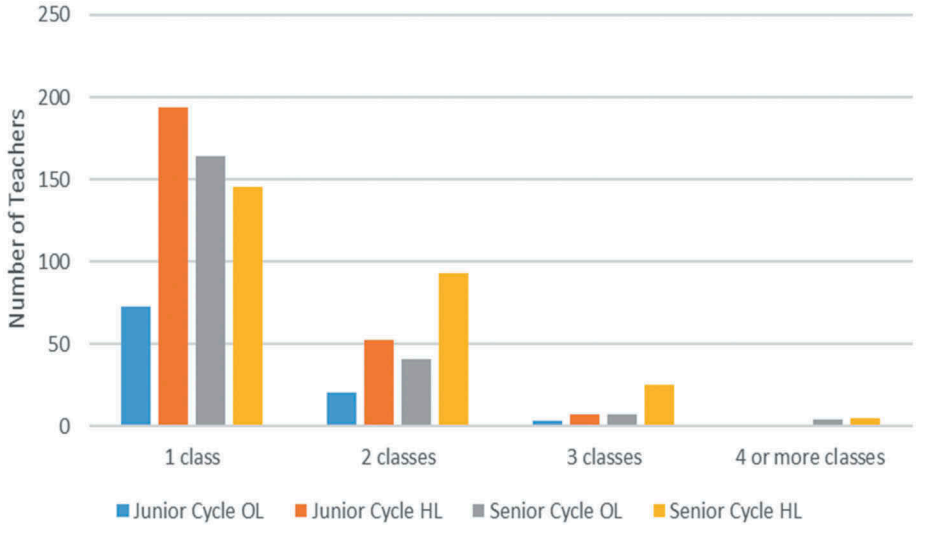

Figure 2. Number of additional classes provided by teachers per week.

Likewise, at Leaving Certificate level, 24 of the 388 teachers (6.2%) to whom the question was applicable stated that they provide classes on an ad hoc basis as opposed to providing them on a weekly basis:

> T349: [I provide them] In the last 2–3 months prior to the exam.
>
> T454: Coming close to the leaving cert exam I feel I have to give extra classes (from Christmas onwards).
>
> T524: Classes are provide during whole school summer examinations so I am free to work on revision.

In addition to analysing the prevalence of this practice, the authors also sought to investigate how much additional time these voluntary classes afforded students. In order to address this research question, teachers who provided voluntary classes were first asked to provide information on the number of additional, voluntary classes they provided per week. The responses received are shown in Figure 2.

Figure 2 shows that, across all four cycles, the majority of teachers provide one extra class per week. Around 76% of teachers who provide additional classes at Junior Cycle ordinary level stated that they provided one additional class per week while the corresponding figures for Junior Cycle higher level, Senior Cycle ordinary level and Senior Cycle higher level were 75.8%, 75.9% and 54.3%, respectively. Furthermore, a large proportion of teachers who taught higher level mathematics at both Junior (20.5%) and Senior Cycle (34.8%) stated that they provided two additional classes per week.

In addition to providing information on the number of classes provided per week teachers were also asked to state in what year they began providing the classes and how many minutes these classes equated to. The responses received are summarized in Figure 3 and Figure 4.

At both Junior Cycle higher and ordinary level, the majority of teachers (88.25% and 81.25%, respectively) commence the voluntary classes in 3rd year (the final year of the Junior Cycle) while the majority of these classes (42.13% and 46.87%, respectively) typically last between 20 and 40 min. A large proportion of teachers (33.46% and 33.38%, respectively) also reported that they provided classes which lasted between 40 and 60 min. At both Senior Cycle higher and ordinary level, the majority of teachers (65.17% and 86.57%, respectively) commence the voluntary classes in 6th year (the final year of the Senior Cycle). While 20–40 min is the typical length of the classes offered by the majority of teachers at ordinary level (40.28%), the majority of classes at higher level lasted for between 40 and 60 min (31.84%). In addition to this, at higher level, a large proportion of

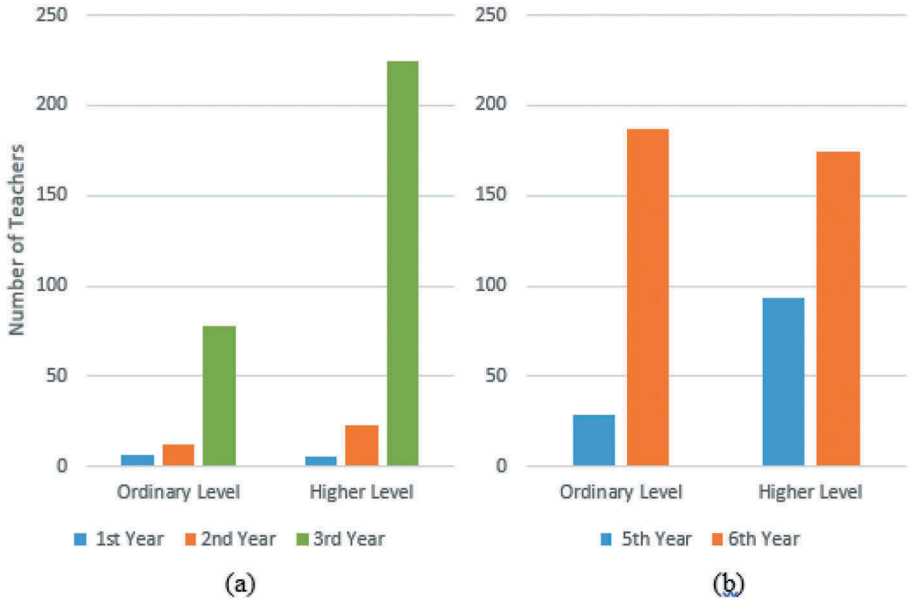

Figure 3. (a) Year in which additional classes commence for Junior Cycle (b) Year in which additional classes commence for Senior Cycle.

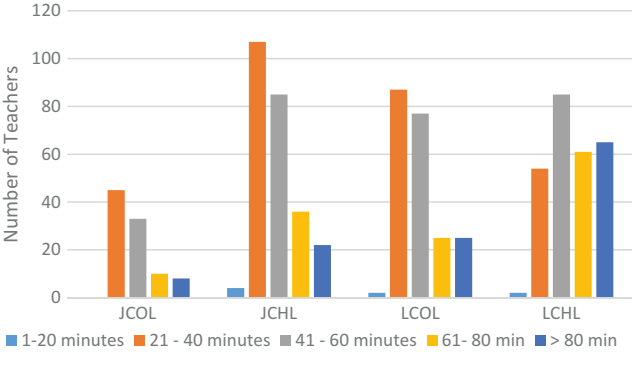

Figure 4. Typical duration of additional classes (Key: JCOL = Junior Certificate Ordinary Level; JCHL = Junior Certificate Higher Level; LCOL = Leaving Certificate Ordinary Level; LCHL = Leaving Certificate Higher Level).

teachers who responded said that they provided in excess of 60 min additional time for mathematics per week (47.19%). Fourty-eight of these teachers commenced voluntary classes at the beginning of 5th year meaning that their students received at least 3,972[2] additional minutes or 66.2 additional hours over the course of the two years than students of the 121 teachers who stated that they did not provide voluntary classes to Senior Cycle higher level students.

Having analysed the prevalence and impact of this practice, the authors then sought to address the third and final research question, which investigated teachers' rationale for providing, or not providing voluntary mathematics classes outside of school hours. In order to determine these reasons the authors analysed the qualitative data provided by teachers when they were asked to provide reasons for providing or not providing additional mathematics classes. At Junior Cycle, 423 of the 540 teachers who responded answered this question with 252 providing reasons as to why

Table 4. Top 3 reasons for providing voluntary mathematics classes.

Reason	No. of Participants	Sample Responses
'The classes enable me to complete the course'	119 (47.2%)	T67: It is necessary to complete the course for students to complete the exams. T95: …to complete the course and give students the time they need to gain a deep understanding of the concepts.
'The classes allow me time to practice exam questions'	73 (29%)	T102: Not enough time in classes allocated to do exam papers and extra questions. T175: I provide extra classes to go through exam questions, help students revise and enhance problem solving skills. It is not possible to do all this during the current class allocation times if the course is to be thoroughly completed.
'The classes afford me the time to complete revision'	72 (28.6%)	T133: It is not possible to complete the Higher Level course in the allocated time in school. The majority of revision has to be done in block class times outside of school hours at weekends or holiday times. T235: These additional classes are used to do revision which would not be completed otherwise.

they did provide additional mathematics classes outside of normal school hours and 171 offering reasons as to why they did not. The three main reasons cited by teachers for providing the additional classes at Junior Cycle are provided in Table 4.

In addition to the three most popular reasons for providing additional classes, other reasons given by some teachers in the study were so that they could:

- adhere to the teaching methodologies promoted by the new curricula (n = 34);
- offer assistance to weaker students (n = 19);
- attend to the needs of students on an individual basis (n = 9);

or because they felt pressurized to provide such classes by parents and students (n = 8).

In contrast, the main reasons offered by teachers as to why they do not provide these extra classes are provided in Table 5.

Table 5. Top 3 reasons for not providing voluntary mathematics classes at junior cycle.

Reason	No. of Participants	Sample Responses
'Additional classes are not necessary'	72 (47.1%)	T53: This year we have stuck very closely to our year plan. As such we will cover the course in time. However ideally we would have had more time to explore concepts more with students. T83: Not required for Junior Cert Ordinary level or Higher level as all is covered in class. T220: Ordinary level[3] students can adequately finish the course in class time.
'Additional classes are not feasible due to time constraints'	53 (31%)	T65: I do not have the time to give extra classes. I get the course just about covered and students revise on their own. T124: I have an Ordinary Level Junior Cert group, and while I am under pressure with the syllabus, I don't have the time to give an extra class in my own time, what with lunch, S + S [study and supervision], sports at lunch, etc.
'Classes not provided as I do not agree with them in principle'	36 (21.1%)	T29… It is the schools job to provide enough maths classes. T33: I have refused to do this, it is completely unacceptable. I take the textbook and…count my 30 odd weeks contact time and divide the course up accordingly. There are other teachers…who have done at least one hour per week with their 3rd and 6th years and, to be honest, it has become expected of us maths teachers. I take offence to this!…The answer may not be more contact time but possibly reduce the course, provide more tangible resources, stop taking a 'cop out' attitude.

Table 6. Top 3 reasons for providing voluntary mathematics classes at senior cycle.

Reason	No. of Participants	Sample Responses
'The classes enable me to complete the course'	183 (32.1%)	T17: The course is too big!! It is one big rush. It was high handed of the department to laud such demands on us. Ideal: I love the new teaching methods. Reality: No time. If I was to teach it the way the inspector wants me to, I will never finish the course not to mention having sufficient revision time. T55: To complete the curriculum, to teach for understanding and to help students to reach their potential. Senior curriculum/syllabus is far too long to be completed over two school years. T64: Not possible to cover syllabus in time allocated. Even with one and a half hours extra per week I cannot spend the time necessary to actively let students explore problems. Time constraints often lead to lecture style classes, which is not what project maths is about.
'The classes allow me time to practice exam questions'	78 (24.5%)	T22: To build their confidence when doing exam questions and to adequately revise the course… T280: My senior cycle students wanted extra classes so as to facilitate the completion of more practise exam papers and exam type questions.
'The classes afford me the time to complete revision'	77 (24.7%)	T402: Not enough teaching hours in the week. . ..Extra classes are needed to ensure the course is completed and revision gets done. T456: I generally teach leaving certificate higher level. I am under constant pressure to get the course fully covered and therefore need to provide the extra classes to get the material covered and get extra revision done. Any leaving certificate higher teacher I know is providing extra voluntary classes.

Other reasons which were not as prevalent but were still offered by a number of teachers as to why they did not provide voluntary classes at Junior Cycle included additional classes at Senior Cycle being prioritized (n = 15) and Government legislation meant that any spare time they did have was already consumed (n = 12).

In the survey, teachers were also asked to provide reasons why they did or did not provide additional voluntary classes at Senior Cycle and the authors carried out a similar analysis on this data. Around 420 teachers responded to this question with 318 teachers offering reasons as to why they provided additional voluntary classes and 102 offering reasons as to why they did not provide such classes. The most popular reasons for providing additional voluntary mathematics classes at Senior Cycle, along with a selection of responses, are provided in Table 6.

Changes to teaching approaches being promoted by the new curricula and the introduction of bonus points was the fourth most popular reason offered by 56 teachers in the study, while the provision of additional support for students was the reason cited by 23 teachers.

The main reasons offered by teachers for not providing these extra classes at Senior Cycle are outlined in Table 7.

Other reasons which were not as common but were still offered by a number of teachers as to why they did not provide voluntary classes at Senior Cycle included that there was no need for such classes (n = 19) and Government legislation meant that any spare time they did have was already consumed (n = 10).

Discussion

First and foremost, this paper sought to conduct a case study to investigate the provision of 'hidden', out-of-school mathematics lessons in Ireland. There is unambiguous evidence presented in this study to confirm the prevalence of these additional classes. The majority of teachers who responded provide additional classes in their own time and without pay. At Junior Cycle, 23% of ordinary level teachers and 55% of higher level teachers reported offering additional mathematics classes on a weekly basis. The corresponding figures for Senior Cycle were 49% for ordinary level

Table 7. Top 3 reasons for not providing voluntary mathematics classes at senior cycle.

Reason	No. of Participants	Sample Responses
'Additional classes are not feasible due to time constraints'	34 (33.3%)	T198: Very busy, short lunch, personal commitments after school. Have maths in all years so have lots of extra prep [aration] with new course. T430: I have provided classes previously but as pressures/ responsibilities have increased in school due to freeze on posts and more project work/evaluation of students and paper work, there is no free time to give. I refuse to for time pressure and mental health preservation.
'Classes not provided as I do not agree with them in principle and it is not the teachers responsibility'	33 (32.4%)	T49: I do not do this as a point of principle. I work through material at a fast pace, and if there are students who cannot keep up, then I recommend grinds to their parents (not taught by me). Again on principle. T129: I did a number of years ago, for 90 min every Wednesday evening. This impacted on my home life. Following the publication of results in August, not one student in the class contacted me to say thanks. . .After that, I decided never again. There are many teachers giving extra classes outside regular hours. This is grossly unfair on them, as they get no recognition for giving these classes. Is Project Maths [current mathematics syllabus] just a cheap way of getting free and extra labour from maths teachers?? T134: It is completely unreasonable to expect maths teachers to give voluntary classes. The instructional time allocated should be enough
'Students did not/would not attend'	20 (19.6%)	T13: Senior Cycle Ordinary level students were offered additional classes but no students decided they would avail of them. T152: I have a full timetable and I have done so before but found that maybe half the class could attend but some could not due to buses, sports, music practise etc. There then was an expectation that I would provide more classes. It just got messy and parents would get involved and pressurize to put more classes on if their child missed and extra class.

and 69% for higher level. With the exception of Junior Cycle ordinary level, these figures are all considerably higher than the OECD average of 37.9% (OECD, 2013). In the OECD (2013) report, countries such as China and Japan reported that a much greater proportion of their students engaged in out-of-school mathematics lessons compared to the OECD average (69.8% and 70.7%) while Irish students were below the OECD average (24.1%). However, this study, which investigated this issue from a teachers' perspective as opposed to a students' perspective, indicated that the percentage of students who have access to additional mathematics classes is closer to the percentages reported in China and Japan as opposed to the OECD average. Furthermore, when the ad-hoc classes are also included in this figure the percentage of teachers who offer additional mathematics classes at Senior Cycle higher level (76.2%) exceeds the figures in both Japan and China and is the second highest, behind Vietnam, across all OECD countries (OECD, 2013). The stark contrast in the results between the OECD study and this study indicate that, internationally, similar studies should be conducted to ascertain if the OECD figures are truly reflective of current practices in any given country.

Another key area of investigation for this research study was the amount of extra time that these additional classes afforded students. In the OECD report (2013), the time spent in after school study was investigated under five main headings: homework, work with personal tutor, after school classes organized by a commercial company, study with a family member or work on a computer. However, voluntary classes proved by teachers free of charge did not feature in the OECD report

and the authors sought to address this gap in the research. At Junior Cycle, the majority of teachers assigned an additional 21–40 min to mathematics per week on a voluntary basis. At ordinary level, 37 of the 45 teachers who afforded this amount of time began these classes at the start of third year and hence their students would be afforded between 11.59 and 22.07 additional hours of mathematics compared to students who did not have access to such classes. This was also the case for 97 of the 107 Junior Cycle higher level teachers who reported allocating an additional 21–40 min. A large proportion of Junior Cycle teachers at both ordinary and higher level also reported allocating between 41 and 60 min per week. At higher level, 8 of these teachers commenced their classes in 2nd year meaning their students were exposed to an additional 45.24–66.2 h of mathematics over the course of Junior Cycle while the 77 teachers who commenced these classes in 3rd year afforded their students an additional 22.62–33.1 h over the course of the year. This shows how these classes enabled teachers to augment in-class time with this hidden time. Senior Cycle teachers relayed a similar story. Around 21–40 min was again the most popular time allocated to additional mathematics classes but a much greater proportion of teachers, particularly at higher level, offered an additional 61–80 min or classes that were in excess of 80 min. For example, 6 teachers at ordinary level and 23 teachers at higher level offered classes that exceeded 80 min in duration per week and these commenced in fifth year. This resulted in their students receiving a minimum of 5,296 additional minutes or 88.27 additional hours of mathematics over the course of their Senior Cycle studies. These statistics all serve to highlight a pressing issue regarding inequities in the provision of time for the study of mathematics across post-primary schools. In a study carried out by Prendergast and O'Meara (2016c) there was found to be an inequity in the time allocated to mathematics during the school day. Further inequities have now been unearthed in this study in relation to another aspect of the time quantum, namely the amount of time allocated to mathematics on a voluntary basis outside of the school day. Due to the correlation between time allocation and achievement in mathematics, as discussed by Benavot and Amadi (2004), these findings indicate that some students are not given the same opportunities as other students to succeed in mathematics. It is putting some students at a significant advantage in terms of their appreciation of, interest in and achievement in the subject of mathematics.

Finally, the study sought to unearth the reasons why teachers do or do not provide additional classes on a voluntary basis. The findings in this study contradict those put forward by the OECD (2013). In the OECD study, principals were asked to state whether the classes were for remedial purposes; for remedial and enrichment purposes; for enrichment purposes only or if they were provided without differentiation, depending on students' prior achievement. In the OECD study, the majority of Irish respondents stated that the classes were either for remedial purposes only (34%) or for both remedial and enhancement purposes (45.5%). This was in line with the OECD average. However, in this study only 7.5% of teachers who offered additional classes at Junior Cycle stated that they were for remedial purposes while the corresponding figure for Senior Cycle was 7.2%. Furthermore, no teachers in the study stated that the classes were for enrichment purposes. The discrepancies between the responses received in this survey and those presented in the OECD study are most likely down to the fact that this study sought the views of the teachers providing the classes as opposed to the principals who facilitate the additional classes in their school. Furthermore, in this study the reasons were ascertained through the use of open-ended questions as opposed to providing participants with a pre-determined list of options. This allowed teachers to be truthful and express their own viewpoints without judgement and as a result, the main reasons for providing additional mathematics classes in this study differ greatly from those outlined in previous international studies. Despite the discrepancies between this study and the OECD studies, the most prevalent reasons provided by teachers in this study do support the findings of other studies that have been conducted. For example, across both Junior and Senior Cycle, teachers stated that the classes were necessary in order to complete the mathematics curriculum while a large proportion of teachers also felt that the classes were necessary to allow them to incorporate

revision of topics during the academic year. This supports the findings of the IMTA (2012). In their report teachers state that *'Teachers now feel that it is impossible and unmanageable to cover the content in the class time provided … no revision time is built in to the syllabus and students are poor at taking responsibility for their own learning'* (Irish Mathematics Teachers Association, 2012, 5–6). It also supports the findings of Fowler and Poetter (2004) who found that French teachers believed there was not enough time allocated to mathematics education and this hindered their ability to plan meaningful and worthwhile lessons. From this, it is evident that teachers concerns regarding the time allocated to mathematics is the driving force behind them providing classes outside of the school day on a voluntary basis. This issue of a lack of contact hours with students is something that is reported by teachers internationally and so it is necessary to extend this study and investigate if teachers in a range of countries and across a range of subjects are using 'hidden curriculum time' to counteract the perceived lack of time available to them at post-primary level.

Conclusion

Overall, the findings of this study highlight a serious issue concerning the quantum of time allocated to mathematics. The results of this study show that the inequity in the time afforded to students to learn mathematics during the school day, which was reported in the work of Prendergast and O'Meara (2016a, 2016c), is exacerbated when the phenomenon of out-of-school mathematics lessons is considered. This combined with the fact that there is no set homework guidelines means that there are undoubtedly inequities across three of the four manifestations of curriculum time detailed earlier in this article. Solely focusing on the 'hidden' curriculum time highlighted to the authors that, depending on the school a student attends or the class teacher to whom they are assigned, the student can receive anything from zero additional minutes of mathematics outside of school hours up to 132.4 h over the course of Junior Cycle (in two extreme cases). This figure stood at 88.3 h over the course of Senior Cycle. The reasons provided by teachers for providing or not providing additional mathematics classes indicate that teachers' personal circumstances, individual viewpoints or commitments outside of school can result in some students being exposed to mathematics for significantly shorter periods of time in Irish post primary schools.

The statistics presented in this study provide evidence that demonstrates a serious inequity in the Irish education system and action needs to be taken to ensure that students are not disadvantaged depending on the school they attend or the class teacher they are assigned. Furthermore, other education systems around the globe also need to consider conducting similar case studies to ensure that their students are not experiencing similar inequities. While in Ireland the DES has recommendations in place in relation to the time that should be assigned to mathematics, these are being adhered to haphazardly by schools, as reported by Prendergast & O'Meara (2016a, 2016b). Similar findings are reported in the international arena by the Eurydice Network (2014b) and Fowler and Poetter (2004). This study has shown that the knock on effect of this is that some teachers are unhappy with the time allocated to mathematics while others feel they are at a disadvantage when they compare the time they are assigned to that of their colleagues in other schools. These teachers then feel they have no option but to provide additional classes to complete the mathematics curriculum and allow time for revision. If such feelings exist in other countries or across other curriculum subjects then similar issues such as those reported in Ireland undoubtedly exist. The authors firmly believe that this cannot be a problem contained within Ireland's borders and so advocate that this study be used as a model for international investigations into the issues brought to the fore here.

In light of this study, government agencies, such as the DES in Ireland, need to review the recommendations currently in place and investigate ways that instruction time can be implemented fairly across all schools. They need to ensure that the time recommended for mathematics is realistic and they need to work with curriculum developers to decide on time recommendations and a curriculum that are aligned and feasible.

In addition to reviewing the recommendations for the time assigned to mathematics, and how this is adopted in schools, global attention must also be given to how teachers use the time available to them. According to Phelps et al. (2012), increasing the time allocated to mathematics alone will not lead to an increase in academic achievement. This will only materialize if teachers use the time assigned to teach mathematics effectively. As such, the authors firmly believe that teachers need formal training in this regard. Continuous Professional Development [CPD], which offers teachers suggestions, ideas and strategies about how best to use the time assigned to mathematics needs to be made available. Teachers need to see how they can integrate 'exam questions' in their everyday teaching and how they can reduce the revision time needed by incorporating teaching for understanding in the classroom. If teachers are equipped to do this then many of the reasons for providing additional classes will be addressed and the need for such classes will diminish. This in turn will lead to a fairer mathematics education system for all.

There are some limitations to the study. The authors used a stratified random sample of 400 s level schools, which was intended to cover 55% of the school population. However, the response rate of 540 teachers across 229 schools means that the findings are only representative of 32% of the entire second level sample. In addition to this, the authors are cognizant of the fact that the 540 teachers who responded all did so voluntarily and this may have led to some bias in the findings presented. These teachers may be the ones who felt most aggrieved by the time allocated to mathematics in their school setting and as such the results may be slightly skewed. It is anticipated, however, that the representative nature of the sample in terms of geographical location and school type would help to reduce some of this potential bias. Furthermore, this study focused specifically on mathematics and failed to determine if this was an issue across other school subjects. However, the authors firmly believe that in schools worldwide subjects are competing against each other and this competition manifests itself in the dimension of time. As such, they propose that the case study offered here be applied to other curriculum subjects to determine if similar issues exist. This is an area of research that could be considered in the future.

Despite these limitations, this study brings to the fore an issue that needs to be looked at by policymakers and those with an invested interest in mathematics education. While the study provided an array of findings, it also raised a number of questions. Is the time recommended for mathematics adequate? Does teacher profile play a role in determining whether students receive additional mathematics lessons? How can we ensure a fair mathematics education experience for all students? Is this an issue confined to the mathematics curriculum or are the teachers of other subjects faced with similar dilemmas and are they addressing such issues through the use of 'hidden' time? Only when these questions are addressed can policymakers begin to resolve issues surrounding inequity in the time assigned to mathematics education and steps can be taken to ensure a fair and balanced education system for all. Only when this materializes will every student have an equal chance to succeed in the mathematics curriculum that they must study.

Notes

1. In Ireland a secondary school are privately owned and managed. They are under the trusteeship of religious communities, boards of governors or individuals. Vocational are owned and run by local Education Training Boards while vocational and community are managed by boards of management which are representative of local interests. The schools are financed entirely by the Department of Education and Skills.
2. This figure was calculated based on 33.1 school weeks per year.
3. Twenty-four of the seventy-two teachers who cited lack of necessity as a reason indicated in their responses that it was ordinary level they were teaching.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by the Irish Research Council [13364];

Notes on contributors

Dr Niamh O'Meara is a lecturer in mathematics education in EPI*STEM, the national centre for STEM education, University of Limerick at the School of Education, A1-065, Main Building, University of Limerick, Limerick; email: niamh.omeara@ul.ie. Her research interests include the knowledge required for mathematics teaching, the allocation of time to mathematics at post-primary level and investigating pre-service teachers' conceptual understanding.

Dr Mark Prendergast is an assistant professor in mathematics education at Trinity College Dublin. His research interests are in teacher education and mathematics education, with a particular interest in the teaching and learning of algebra at second level.

ORCID

Niamh O'Meara http://orcid.org/0000-0002-6959-2783
Mark Prendergast http://orcid.org/0000-0002-1766-7421

References

Anderson, L. W. (1981). Instruction and time on-task. *Journal of Curriculum Studies*, *13*(4), 289–303.

Benavot, A., & Amadi, M. (2004). *A global study of intended instruction time and official school curricula, 1980-2000. Background paper commissioned by the International Bureau of Education for the UNESCO- EFA Global Monitoring Report (2005): The Quality Imperative*. Geneva: IBE.

Carroll, J. B. (1963). A model of school learning. *Teachers College Record*, *64*, 723–733.

Carroll, J. B. (1989). The Carroll Model: A 25-year retrospective and prospective view. *Educational Researcher*, *18*, 26–31.

Clark, D., & Linn, M. C. (2003). Designing for knowledge integration: The impact of instructional time. *Journal of the Learning Sciences*, *41*(4), 451–493.

Cooper, H., Robinson, J., & Patall, E. A. (2006). Does homework improve academic achievement? A synthesis of research: 1987-2003. *Review of Educational Research*, *76*(1), 1–62.

Cosgrove, J., Perkins, R., Shiel, G., Fish, R., & McGuinness, L. (2012). *Teaching and learning in Project Maths*. Dublin: Educational Research Centre.

Cotton, K., & Wikelund, K. (1990). *Educational time factors*. Portland, Oregon: Northwest Regional Educational Laboratory.

Department of Education and Skills. (2010). *Report of the Project Maths implementation support group*. Dublin: Author.

Eurydice Network. (2014a). *Recommended annual taught time in fulltime compulsory education in Europe 2013/14*. Brussels: EU Education, Audio-visual and Culture Executive Agency.

Eurydice Network. (2014b). *Comparative overview on instruction time in fulltime compulsory education in Europe 2013/14*. Brussels: EU Education, Audio-visual and Culture Executive Agency.

Farrow, S., Tymms, P., & Henderson, B. (1999). Homework and attainment in primary schools. *British Educational Research Journal*, *25*(3), 323–341.

Ferreras, A., & Olson, S. (2010). *The teacher development continuum in the United States and China: Summary of a workshop*. Washington, DC: The National Academies Press.

Fowler, F. C., & Poetter, T. S. (2004). Framing French success in elementary mathematics: Policy, curriculum and pedagogy. *Curriculum Inquiry*, *34*(3), 283–314.

Gaines, K. L. (2012). *Why are students not learning on the school bus? The future of learning outside the classroom in American schools*. Bloomington, Indiana: iUniverse.

Glatthorn, A., Boschee, F., Whitehead, B., & Boschee, B. (2012). *Curriculum Leadership: Strategies for development and implementation*. California: Sage Publishing.

Harn, B. A., Thompson, S. L., & Roberts, G. (2008). Intensifying instruction: Does additional instruction time make a difference for most at-risk first graders? *Journal of Learning Disabilities*, *41*(2), 115–125.

Irish Mathematics Teachers Association. (2007). IMTA Newsletter 107. Retrieved from http://www.imta.ie/wp-content/uploads/2016/02/Newsletter107.pdf

Irish Mathematics Teachers Association. (2012). *Project maths and the Irish maths teachers association*. Cork: IMTA.

Jackson, J., & Harbison, L. (2014). An evaluation of the utility of homework in Irish primary school classrooms. *Irish Teachers' Journal*, *2*(1), 47–63.

Karweit, N. L. (1984). Time on task reconsidered: Synthesis of research on time and learning. *Educational Leadership*, *41* (8), 32–35.

Murphy, C., Lundy, L., Emerson, L., & Kerr, K. (2013). Children's perceptions of primary science assessment in England and Wales. *British Educational Research Journal*, *39*(3), 585–606.

National Council of Teachers of Mathematics: Comission of Standards for School Mathematics. (1989). *Curriculum and evaluation standards for school mathematics*. Chicago: National Council of Teachers of Mathematics.

OECD. (2011). *Quality time for students: Learning in and out of school*. Author. Retrieved from http://www.oecd-ilibrary.org/education/quality-time-for-students-learning-in-and-out-of-school_9789264087057-en

OECD. (2013). *PISA 2012 results: What makes schools successful? Resources, policies and practices (Volume IV)*. Author.

OECD. (2014). *Education at a Glance 2014: OECD Indicator* (pp. 427–442). Author. Retrieved from https://www.oecd.org/edu/Education-at-a-Glance-2014.pdf

OECD. (2014a). Does homework perpetuate inequities in education. *Pisa in Focus*, (46). Retrieved from http://www.oecd-ilibrary.org/education/does-homework-perpetuate-inequities-in-education_5jxrhqhtx2xt-en

Phelps, G., Corey, D., DeMonte, J., Harrison, D., & Loewenberg Ball, D. (2012). How much English language, arts and mathematics instruction do students receive? Investigating variation in instructional time. *Educational Policy*, *26*(5), 631–662.

Prendergast, M., & O'Meara, N. (2016a). A time profile of mathematics in a 'gap year' in Irish secondary schools. *European Journal of Science and Mathematics Education*, *4*(3), 293–304.

Prendergast, M., & O'Meara, N. (2016b). Assigning mathematics instruction time in secondary schools: What are the influential factors? *International Journal of Mathematical Education in Science and Technology*, *47*(8), 1137–1155.

Prendergast, M., & O'Meara, N. (2016c). A profile of mathematics instruction time in Irish second level schools. *Irish Educational Studies*, *36*(2), 133–150.

Veal, W. R., & Flinders, D. J. (2001). How block scheduling reform effects classroom practice. *The High School Journal*, *84* (4), 21–31.

Wiley, D. E., & Harnischfeger, A. (1974). Explosion of a myth: Quantity of schooling and exposure to instruction, major educational vehicles. *Educational Researcher*, *3*(4), 7–12.