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Educational Inequality in Primary Schools in Ireland in the Early Years of the National Literacy and Numeracy Strategy: An Analysis of National Assessment Data

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Drawing on data from the National Assessments of Mathematics and English Reading (NAMER) 2009 and 2014, the current study compares inequalities in reading and mathematics achievement that may be attributed to demographic and socioeconomic characteristics, before and after the initial implementation of the *National Literacy and Numeracy Strategy 2011-2020*. The results indicate that the improvements in overall pupil performance, observed following the initial implementation of the Strategy, were accompanied by reduced inequalities. While all examined groups of pupils saw improvements in both reading and mathematics over time, the improvements particularly favoured groups of pupils who had lower performance than their counterparts in 2009, leading to smaller performance gaps in 2014. The findings are complemented by the results of multilevel analysis which showed a significant reduction in the variance in pupil performance attributable to between-school differences, as well as to selected demographic and socioeconomic factors, after the introduction of the Strategy. The implications of these and other findings are discussed.

Keywords: national assessments, mathematics, equality, National Literacy and Numeracy Strategy

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National and international large-scale assessments have become important tools for assessing the quality of education systems (Greaney & Kellaghan, 2008). They can be used to determine how well pupils are learning, identify strengths and weaknesses in the knowledge and skills that pupils have acquired, explore factors that might be associated with pupil achievement, and compare the achievement of population subgroups. Information gathered in such assessments can support evidence-based policy and sound decision-making. Cyclical administration of standardised assessments can help to determine whether standards improve, deteriorate or remain static over time (Greaney & Kellaghan, 2008). National assessments, specifically, can focus on selected aspects of a particular country's educational system, and allow for greater flexibility than international assessments, as far as the design, implementation and reporting are concerned. Empirical evidence gathered in national assessments can also help to draw attention to issues related to access, quality, efficiency, and/or equity (Kellaghan et al., 2009).

In the Irish context, results of large-scale assessments are used to inform educational policy development. One such example is the introduction of the *National Literacy and Numeracy Strategy 2011-2020* (hereafter also referred to as the Strategy), which aimed to improve literacy and numeracy among children and young people at all levels of the education system. The Strategy was published by the Department of Education and Skills (DES) in 2011, in response to concern about unsatisfactory literacy and numeracy performance on national and international assessments. It stated that 'the literacy skills of pupils in Irish primary schools, measured by the National Assessments of English Reading, have not improved in over thirty years, despite considerable investments in reducing pupil-teacher ratios, the introduction of learning support (formerly remedial) and resource teachers, the provision of better teaching materials and considerable curricular reform' (DES, 2011, p. 12). It also referred to weak performance among primary school pupils on important content areas and skills of the mathematics curriculum such as measures and problem solving (DES, 2011).

Significant declines in reading literacy and mathematics performance among 15-year-olds in Ireland had been observed in the 2009 OECD Programme for International Student Assessment (PISA); these were interpreted by politicians and education officials as a mandate for reform. Specifically, in reading, Ireland's mean score in PISA 2009 was 31 points (one-third of a national standard deviation) lower than the country's mean score in PISA 2000 (Perkins et al., 2012). Similarly, in mathematics, Ireland's mean score in 2009 dropped by 16 points (one-sixth of a national standard deviation) since 2003. Furthermore, for both reading and mathematics, the proportions of low-performing pupils were higher in PISA 2009 than in previous cycles.

The Strategy outlined a broad range of measures aimed at improving pupils' competence in literacy and numeracy, including increased instructional time, enhanced teacher preparation, and a stronger focus on learning outcomes and

analysis of achievement data in schools. Targets were also set specifically in relation to the National Assessments of Mathematics and English Reading (NAMER), to increase the performance of pupils across the performance continuum (DES, 2011).

As well as improving *overall* levels of literacy and numeracy, the Strategy aimed to achieve greater equality in literacy and numeracy outcomes, and in so doing, alleviate educational disadvantage by reducing performance gaps attributed to pupil background characteristics. The importance of targeted support for pupils at risk of low performance was emphasised, with particular reference to pupils from socioeconomically disadvantaged backgrounds, 'because of the enormous impact improvement can have on the life-chances of these young people and also because it fosters greater equity in the education system and society in general' (DES, 2011, p. 65). Migrant pupils[1] were also noted in the Strategy as a group in need of targeted support to reduce performance gaps; evidence from PISA 2009 was used to describe how migrant pupils, whose first language is not the language of the school, perform less well in literacy than their native peers.

Subsequent to the introduction and initial implementation of the Strategy in 2011, significant improvements were observed in pupils' reading and mathematics performance in national and international assessments [Trends in International Mathematics and Science Study (TIMSS), Progress in International Reading Literacy Study (PIRLS) and PISA] (Clerkin et al., 2016; Eivers et al., 2017; Perkins et al., 2013; Shiel et al., 2014, 2016). Overall reading and mathematics performance scores were significantly higher in NAMER 2014, compared with NAMER 2009, before the introduction of the Strategy. However, questions remained as to how these improvements were distributed across population subgroups with different demographic and socioeconomic characteristics, and the extent to which the performance gaps between these subgroups may have reduced. When improvements in overall pupil performance favour certain 'privileged' groups of pupils, this can lead to or exacerbate educational inequality. In order to address the issue of educational inequality, it is necessary to be able to describe patterns of unevenness and the factors which determine them (UNESCO, 2018).

Ferreira and Gignoux (2014) provide a comprehensive framework for conceptualising and measuring inequality in education by describing two different types of inequality: i) inequality of educational achievement, which simply refers to the degree of variability in pupil performance, and ii) inequality of opportunity, which can be described as the extent to which background, demographic, socioeconomic and other predetermined characteristics (e.g., gender) shape pupils' academic performance.

1 This is the term used in the Strategy. This subgroup is also referred to variously as 'newcomer' or 'immigrant' or 'non-native' and refers to pupils who were not born in Ireland and so may have had less experience of the Irish education system and languages of Ireland than 'native-born' pupils.

The Current Study

Although pupils' performance on national and international assessments significantly improved after initial implementation of the Strategy, an in-depth investigation of the impact of this reform on equality among different groups of pupils has not been conducted. Drawing on Ferreira and Gignoux's (2014) framework, this study examines educational inequality in Ireland, focusing on the time periods before and after the introduction and initial implementation of the National Literacy and Numeracy Strategy. Data from NAMER 2009 and 2014 were used to investigate whether improvements in 6th class pupils' overall reading and mathematics performance are accompanied by improvements in equality of achievement and alleviation of subgroup performance differences. Pupils in 6th class are an important cohort, since they are approaching the end of primary education, and an in-depth investigation of their scores has not yet been conducted.[2] Comparing evidence from before and after initial implementation of the Strategy, the current study examines changes in the variability in pupil scores, performance gaps attributed to demographic and socioeconomic factors, and the extent to which such gaps contribute to the explanation of pupil performance in reading and mathematics. Additionally, the study aims to examine whether and to what extent evidence from different subjects (i.e., reading and mathematics) yields consistent results, where equality is concerned.

Method

Data

This paper presents a secondary analysis of the NAMER 2009 and 2014 data. NAMER is a cross-sectional study that takes place approximately every five years in a representative sample of Irish primary schools to facilitate evidence-based policy decisions (Eivers et al., 2010; Shiel et al., 2014). Historically, national assessments covered various class levels and domains. However, the Department of Education and Skills decided that, from 2009, national assessments would be implemented in 2nd and 6th classes, and would assess English reading and mathematics.

Participants

In each NAMER cycle, a nationally representative sample of primary-school pupils is selected, using a two-stage cluster sampling methodology. Specifically, after selecting a representative sample of schools, using stratified sampling and based on probability

2 Kavanagh et al. (2015) conducted a detailed analysis of 2nd class pupils' reading performance in NAMER 2014, examining a number of explanatory factors. However, this analysis did not particularly emphasise inequalities in the context of the National Literacy and Numeracy Strategy.

proportional to size, a number of 2nd and 6th grade classes within each school are randomly selected to take part in the study (with a maximum of two classes at each grade). In this paper, data on 6th class pupils are presented. Table 1 presents the sample sizes in NAMER 2009 and 2014 for each subject.

TABLE 1

Sample Sizes in NAMER 2009 and 2014 – 6th Class

	Number of schools	Number of pupils	
		English Reading	Mathematics
NAMER 2009	139	3803	3832
NAMER 2014	140	4166	3312

Note. In NAMER 2014, a total sample of 4144 pupils completed the mathematics assessment. However, a fraction of the sample (20%) took experimental test booklets comprising fewer items; these pupils were excluded from the analyses in this paper to facilitate comparisons of mathematics scores across the years.

Measures

The reading assessment framework used for the development of the NAMER tests in 2009 and 2014 defines reading as 'the process of constructing meaning through the dynamic interaction among the reader's existing knowledge, the information suggested by the written language, and the context of the reading situation' (Eivers et al., 2005, p. 15). In both cycles, the structure of the reading test was the same: a short vocabulary section followed by two comprehension sections. Core reading skills, such as the ability to decode and process the meanings of words and sentences, were assessed in the vocabulary section. The comprehension sections aimed at assessing pupils' ability to construct meaning from extended pieces of text. The texts were classified by purpose (reading for literary experience or reading to acquire information) (Mullis et al., 2006), while the items were classified by the process that the reader must use to interpret the text (retrieve, infer, interpret & integrate, and examine & evaluate). Two-thirds of 6th class comprehension items were multiple-choice items and one-third were short constructed response items.

The final item pool for the 6th class reading booklets in both cycles consisted of 192 items. Of these, 20 were multiple-choice vocabulary items, that were common to all four booklets. The 2014 booklets included two replacement passages and associated items, similar in structure to two retired passages. A further two items, deemed to be problematic in 2009, were also replaced.

Likewise, for mathematics, the same assessment framework was used for the development of the 2009 and 2014 assessments. The framework drew directly on the definition of mathematics in the Primary School Mathematics Curriculum (DES, 1999),

which sees mathematics as 'the science of magnitude, number, shape, space, and their relationships and also as a universal language based on symbols and diagrams. It involves the handling. . . . of information, the making of predictions and the solving of problems through the use of language' (p. 2).

The mathematics assessment consisted of items classified by content areas (algebra, shape & space, measures, and data) that require specific process skills (recall, understand, implement, integrate, connect, reason, apply and problem-solve) (Educational Research Centre, 2009). The regular test booklet in both years comprised 75 items (from a total item pool of 150 items).[3] Each pupil took one of two non-calculator blocks, followed by a common block, and one of three final blocks. Across blocks, 16 items were replaced between 2009 and 2014.

Both reading and mathematics scores were scaled using Item Response Theory (IRT), which facilitated the replacement of small numbers of items between 2009 and 2014. Item parameters and pupil scale scores were estimated iteratively within the IRT scaling software Bilog-MG (Zimowski et al., 1996), with the final parameters and scores representing the 'best fit' solution. Mean scores and standard deviations were set at 250 and 50 respectively in 2009.

In addition to measuring pupils' English reading and mathematics achievements, NAMER collects contextual and background information through pupil, parent/guardian, teacher and school questionnaires. The questionnaires are administered in conjunction with the tests, and can be linked to the achievement data.

To investigate equality in pupil performance across years and subjects, several demographic and socioeconomic factors were examined using data from the questionnaires. Variables related to educational possessions (i.e., number of books at home) and parents' level of education and occupational status[4] were used as proxies for family socioeconomic status. It should be noted that data were not collected on parents' education in NAMER 2009 or on parent occupation in NAMER 2014.

Table 2 presents the variables relating to the background characteristics of pupils that were examined in this study, along with their respective categories and the percentages of pupils belonging to each category. All variables that were not already dichotomous were recoded into binary variables to facilitate the analysis.

3 Experimental test booklets, comprising 50 items, were trialled as part of the 2014 assessment, but pupils taking these booklets were not included for scaling purposes.

4 Occupations, as reported by parents/guardians, were subsequently placed on a scale of socioeconomic status, using the International Socio-Economic Index (Ganzeboom et al., 1992), with higher scores indicating occupations of higher socioeconomic status (e.g., judge or doctor). Maternal and paternal scores were compared and the higher value was used to assign a family occupational status score (Eivers et al., 2009). The scale had a median of 50 and a mean of 48.4 (SD = 16.4).

TABLE 2

Demographic Features of the Samples

Variables	Categories	NAMER 2009		NAMER 2014	
		Reading	Maths	Reading	Maths
		%	%	%	%
Gender (biological sex)	(0) Girl	48.3	48.3	51.4	53.6
	(1) Boy	51.7	51.7	48.6	46.4
Country of birth	(0) Born outside of Ireland	14.9	15.0	11.5	11.7
	(1) Born in Ireland	85.1	85.0	88.5	88.3
Language most often spoken at home	(0) Another language	5.4	5.4	7.1	6.9
	(1) English/Irish	94.6	94.6	92.9	93.1
Number of books at home	(0) 100 books or fewer	56.2	56.5	55.1	54.5
	(1) More than 100 books	43.8	43.5	44.9	45.5
Parent occupational status	(0) Below average	47.1	46.9	–	–
	(1) Above average	52.9	53.1	–	–
Highest level of parent education	(0) No third-level education	–	–	41.8	38.5
	(1) Third-level education	–	–	58.2	61.5
School DEIS status*	(0) Non-DEIS	78.9	78.2	79.8	79.2
	(1) DEIS	21.1	21.8	20.2	20.8

Note. Weighted percentages are presented. Missing cases were excluded.

* DEIS schools are those that are eligible to participate in the Delivering Equality of Opportunity in Schools (DEIS) plan in Ireland which is the current policy to support schools with high concentrations of pupils from socioeconomically disadvantaged families.

Analysis

To examine the reduction of inequalities in pupil performance associated with demographic and socioeconomic factors after the introduction and initial implementation of the Strategy, statistical analysis was conducted in two stages, for both reading and mathematics. In the first stage, bivariate analyses were performed to identify which of the examined pupil- and school-level variables were statistically significantly related to pupil performance, as well as to indicate the magnitude of the performance gaps for each subject.

In stage two, the extent to which each factor contributed to the explanation of pupils' performance, after accounting for the other variables, was examined. The aim was

to quantify the variance in reading and mathematics achievement explained by demographic and socioeconomic factors, and to compare explained variance across cycles. The examined factors were included as explanatory variables in a series of multilevel linear regression models on pupil achievement in reading and mathematics. Models were run in two steps for each subject and each NAMER cycle. In step 1, models included only background variables that were measured in both 2009 and 2014 to allow for comparisons across cycles. In step 2, parent occupational status and level of education were added to the models for NAMER 2009 and 2014, respectively, to further explore the role of these variables in explaining pupil achievement, after accounting for other demographic and socioeconomic factors.

Multilevel analysis was applied to account for the clustered nature of the sample. Although the cluster sample methodology used in NAMER is cost-effective, it is less efficient in terms of the accuracy of population estimates derived from sample data than a simple random sample of pupils. This is because pupils within the selected clusters (classes and schools) may be more similar to each other than they are to pupils in the target population in general. This is an issue in many educational studies, since many statistical models assume that cases in the sample are independent of each other. Lack of independence can lead to underestimation of standard errors, overly narrow confidence intervals and small p-values that subsequently increase the risk of a Type I error (Field, 2017). Multilevel models provide more accurate estimates by estimating the variation in the dependent variable that is attributable to differences within and between clusters (L. Cohen et al., 2011; Tarling, 2009; Woltman et al., 2012). In this study, two-level analysis was applied with pupils at level one and schools at level two. Sampling weights were used at both levels. Replicate weights were also taken into account in the bivariate analyses.

The IBM SPSS Statistics 25 (IBM, 2017), the IDB Analyser 4 (IEA, 2019), and the Mplus 8 (Muthén & Muthén, 2017) software were used to perform the analyses.

Results

Following the introduction and implementation of the National Literacy and Numeracy Strategy from 2011 onwards, Irish primary school pupils' performance on the National Assessments improved significantly in both reading and mathematics. Table 3 shows improvements on NAMER between 2009 and 2014. The magnitude of the changes across cycles for both reading and mathematics is indicated by the respective Hedge's g effect sizes. Although these would typically be classified as small to medium (J. Cohen, 1988), according to the What Works Clearinghouse framework (an initiative of the U.S. Department of Education), effect sizes greater than 0.25 can be viewed as substantively important in educational research (What Works Clearinghouse, 2020).

TABLE 3

Average Performance and Effect Sizes in Reading and Mathematics on NAMER between 2009 and 2014

	Mean (SE)	*g*
Reading		
2009	250.0 (1.82)	0.26
2014	263.0 (1.55)	
Mathematics		
2009	250.0 (2.35)	0.24
2014	261.7 (2.07)	

Note. Effect sizes are provided for statistically significant mean score differences.

Analysis of Reading

Table 4 shows the reading performance gaps for NAMER 2009 and NAMER 2014. Pupils' gender, country of birth, language spoken at home, number of books at home and parent occupational status and level of education are presented, as well as schools' DEIS status.

TABLE 4

Differences in Reading Performance between NAMER 2009 and 2014 for Selected Groups

			Mean (SE)	*g*
Gender	*2009*	*Girls*	*252.4 (2.32)*	–
		Boys	*247.8 (2.43)*	
	2014	Girls	265.6 (2.17)	–
		Boys	260.5 (2.00)	
Country of birth	*2009**	*Ireland*	*252.6 (2.23)*	*0.31*
		Outside of Ireland	*237.3 (3.60)*	
	2014*	Ireland	265.2 (1.74)	0.29
		Outside of Ireland	251.2 (3.50)	
Language spoken at home	*2009**	*English/Irish*	*252.7 (2.06)*	*0.85*
		Other	*211.3 (3.06)*	
	2014*	English/Irish	265.4 (1.46)	0.54
		Other	239.7 (2.89)	
No. of books at home	*2009**	*100 or fewer*	*234.3 (1.79)*	*0.86*
		More than 100	*274.3 (2.64)*	
	2014*	100 or fewer	249.3 (1.56)	0.75
		More than 100	283.0 (1.26)	
Parent occupational status[a]	*2009**	*Below average*	*240.6 (2.13)*	*0.59*
		Above average	*268.1 (2.00)*	
	2014	Below average	–	–
		Above average	–	
Highest level of parent education[b]	*2009*	*No third-level education*	–	–
		Third-level education	–	
	2014*	No third-level education	248.6 (1.78)	0.56
		Third-level education	274.3 (1.32)	
School DEIS status	*2009**	*DEIS*	*231.5 (4.79)*	*0.44*
		Non-DEIS	*253.2 (1.99)*	
	2014*	DEIS	245.8 (3.26)	0.45
		Non-DEIS	267.4 (1.57)	

Note. Effect sizes are provided only for statistically significant differences.

*p < .05.

a Data on parent occupational status were not collected in NAMER 2014.

b Data on parental education were not collected in NAMER 2009.

Most of the background variables, when examined on their own, were statistically significantly related to pupils' reading achievement, in both cycles. Gender was the only variable not significantly related to achievement in either 2009 or 2014. Although girls had a higher mean score than boys in reading in both cycles, the differences were not statistically significant.

In both 2009 and 2014, pupils who were born in Ireland outperformed their peers who were born in another country, with respective effect sizes of 0.31 and 0.29. Similarly, in both cycles, pupils who spoke English or Irish at home performed significantly better than pupils who spoke a different language, with effect sizes of 0.85 in 2009 and 0.54 in 2014. Pupils who had more than 100 books at home scored significantly higher than those who had 100 books or fewer in both cycles, with effect sizes of 0.86 in 2009 and 0.75 in 2014. In both 2009 and 2014, the mean reading scores of pupils in non-DEIS schools were significantly higher than those of pupils in DEIS schools, with respective effect sizes of 0.44 and 0.45.

In 2009, pupils with parents whose occupational status was above the average achieved significantly higher mean reading scores than pupils with parents whose occupational status was below the average (g = 0.59). Similarly, in 2014, the mean reading score of children whose parents had received some third-level education was significantly higher than the mean score of children whose parents had not received any third-level education (g = 0.56).

The performance gaps outlined above yielded considerable effect sizes in both cycles. Some of these were particularly large, such as the differences in reading achievement related to the language spoken at home and the number of books that a family possessed. For most of the variables studied in both cycles for which statistically significant differences were observed between the two groups (country of birth, language spoken at home, and number of books at home), the magnitude of the differences decreased between 2009 and 2014. For example, there was a difference of 41.4 score-points between pupils who spoke English or Irish at home and pupils who spoke a different language in 2009 (g = 0.85), while this gap was much smaller in 2014 (a difference of 25.7 score-points, g = 0.54).

To further examine how these variables contribute to the explanation of pupils' performance in reading, they were included as explanatory variables in a series of multilevel models. Tables 5 and 6 present the results of the multilevel analysis for the National Assessments of reading 2009 and 2014, respectively. Firstly, the null models (without any explanatory variables) were run for both cycles. As indicated by the intraclass correlation coefficients (ICC), there was a considerable decrease in the variance in reading achievement that was attributed to between-school differences between 2009 (ICC = 16.2%) and 2014 (ICC = 9.5%). This is a noteworthy finding since it indicates that reading achievement differences between schools were substantially smaller in 2014 than in 2009. As explained in the methods section, in Step 1, models

that are directly comparable across the two cycles are presented first, as these involve explanatory variables that were measured both in 2009 and 2014. In Step 2, other relevant variables that were measured in only one of the two cycles are added to the models. The multilevel regression results present the unstandardised coefficients (*B*), which are based on raw scores, along with their respective standard errors (*SE*) for each of the examined variables; the values refer to the categories in brackets.

In NAMER 2009 (Table 5), after accounting for the clustered nature of the data and the variance attributed to other variables, the gender difference in reading favoured boys, though it is not statistically significant. Pupils who spoke English or Irish at home, those with more than 100 books at home, and pupils whose parents' occupational status was above average were expected to perform better in the NAMER reading test. Language spoken at home, in particular, was the strongest variable in the final model (Step 2); on average, and with other variables held constant, pupils who spoke English or Irish at home were expected to perform better in reading by 31.4 score-points, compared to their counterparts who spoke a different language. After accounting for the variability in reading achievement due to these three factors, two variables that had been statistically significantly related to reading performance in the bivariate analysis (pupils' country of birth and their schools' DEIS status) were no longer significant. The final model for 2009 explains 15.6% of the overall variance in pupil reading achievement, with language spoken at home being the strongest explanatory variable.

TABLE 5

Multilevel Modelling of NAMER 2009 Reading Achievement

	Step 1 (comparison model)	Step 2 (final model)
Variables	*B (SE)*	*B (SE)*
Pupil-level		
Gender (boys)	2.1 (2.71)	1.2 (2.79)
Country of birth (Ireland)	-0.1 (3.40)	0.4 (3.33)
Language spoken at home (English/Irish)	29.3 (3.85)*	31.4 (4.33)*
Books at home (more than 100)	31.4 (2.86)*	26.2 (3.01)*
Parent occupational status (above average)	–	13.1 (2.38)*
School-level		
DEIS status (DEIS)	-7.1 (6.65)	-5.66 (6.49)
Intercept	209.8 (4.62)*	205.0 (5.12)*
Variance explained		
Pupil-level:	14.9%	17.0%
School-level:	3.3%	2.4%
Overall:	13.6%	15.6%

*$p < .05$.

As shown in Table 6, in the 2014 reading model, more variables retained their statistical significance in explaining reading achievement. Specifically, girls, pupils who spoke English or Irish at home, those with more than 100 books in their home, pupils whose parents had received some third-level education, and those who attended non-DEIS schools were likely to perform better in the NAMER reading test. After accounting for these variables, pupils' country of birth was not a significant explanatory variable of reading performance. The overall variance explained in the final model was 13.3 percent.

TABLE 6

Multilevel Model of NAMER 2014 Reading Achievement

	Step 1 (comparison model)	Step 2 (final model)
Variables	*B (SE)*	*B (SE)*
Pupil-level		
Gender (male)	-4.1 (1.94) *	-4.8 (1.97)*
Country of birth (Ireland)	1.6 (3.91)	3.7 (3.92)
Language spoken at home (English/Irish)	15.3 (3.92)*	12.1 (3.87)*
Books at home (more than 100)	28.4 (1.82)*	23.5 (1.97)*
Parent education (third-level)	–	14.8 (1.87)*
School-level		
DEIS status (DEIS)	-12.5 (3.34)*	-10.0 (3.37)*
Intercept	241.9 (3.41)*	236.0 (3.29)*
Variance explained		
Pupil-level:	11.0%	13.0%
School-level:	28.3%	22.3%
Overall:	11.7%	13.3%

*p < .05.

A comparison of the Step 1 reading models for 2009 and 2014 (which include the same explanatory variables) demonstrates that the proportion of variance in reading achievement attributable to the examined pupil and school characteristics was lower in 2014 (11.7%) compared to 2009 (13.6%). In other words, the magnitude of performance gaps in reading due to the pupil and school characteristics included in the model decreased by 14% after initial implementation of the National Literacy and Numeracy Strategy. Although more variables significantly explained reading achievement in 2014 compared to 2009, including DEIS status, their overall explanatory power was smaller.

Interactions between gender and other pupil- and school-level variables were examined for the final reading models for both 2009 and 2014, but none of these interactions reached statistical significance, when corrections for multiple comparisons were applied.

Analysis of Mathematics

Table 7 examines the mathematics performance gaps for NAMER 2009 and 2014. The table shows pupils' mean performance by gender, country of birth, language spoken at

home, number of books at home, parent occupational status (2009), parent education (2014), and school DEIS status. Again, effect sizes are shown for statistically significant differences between groups.

TABLE 7

Differences in Mathematics Performance between NAMER 2009 and 2014 for Selected Groups

			Mean (SE)	*g*
Gender	2009	*Girls*	*247.0 (3.27)*	–
		Boys	*252.8 (2.48)*	
	2014	Girls	260.0 (2.46)	–
		Boys	263.7 (2.55)	
Country of birth	2009	*Ireland*	*251.1 (2.66)*	–
		Outside of Ireland	*247.9 (3.82)*	
	2014	Ireland	262.4 (2.14)	–
		Outside of Ireland	259.4 (3.10)	
Language spoken at home	2009	*English/Irish*	*251.4 (2.54)*	–
		Other	*240.5 (5.10)*	
	2014	English/Irish	262.3 (2.16)	–
		Other	259.0 (3.42)	
No. of books at home	2009*	*100 or fewer*	*237.6 (2.32)*	*0.70*
		More than 100	*270.4 (3.35)*	
	2014*	100 or fewer	252.0 (2.05)	0.56
		More than 100	277.9 (2.25)	
Parent occupational status[a]	2009*	*Below average*	*241.7 (2.80)*	*0.55*
		Above average	*267.3 (2.73)*	
	2014	Below average	–	–
		Above average	–	
Highest level of parent education[b]	2009	*No third-level education*	–	–
		Third-level education	–	
	2014*	No third-level education	248.4 (2.28)	0.54
		Third-level education	273.4 (2.04)	
School DEIS status	2009*	*DEIS*	*226.9 (5.53)*	*0.58*
		Non-DEIS	*255.1 (2.68)*	
	2014*	DEIS	246.8 (4.79)	0.39
		Non-DEIS	265.7 (2.21)	

Note. Effect sizes are provided only for statistically significant differences.

*p < .05.

a Data on parent occupational status were not collected in NAMER 2014.

b Data on parent education were not collected in NAMER 2009.

In both cycles of NAMER, the number of books in pupils' homes, their parents' occupational status (2009), level of education (2014) and their schools' DEIS status were statistically significantly related to mathematics achievement. Pupils' gender, their country of birth, and language spoken at home were not statistically significantly related to mathematics performance in either cycle. For each of the performance gaps that is statistically significant, substantively important effect sizes were observed.

Pupils who had more than 100 books at home performed significantly better than their peers with 100 books or fewer in both 2009 (g = 0.70) and 2014 (g = 0.56). In 2009, pupils with parents whose occupational status was above average significantly outperformed pupils with parents whose occupational status was below average (g = 0.55). Likewise, in 2014, pupils whose parents had received some third-level education achieved significantly higher mean mathematics scores than pupils whose parents had received no third-level education (g = 0.54). In both cycles, pupils in non-DEIS schools achieved significantly higher mean mathematics scores than pupils in DEIS schools, with effect sizes of 0.58 in 2009 and 0.39 in 2014.

Schools' DEIS status and the number of books at home were the only two variables measured in both cycles for which statistically significant differences were observed between the two groups. For each of these variables, the magnitude of the differences between the two groups decreased between 2009 and 2014. It is noteworthy that the mathematics performance of pupils in DEIS schools improved by 19.9 score-points on average between 2009 and 2014, whereas the improvement for pupils in non-DEIS schools was 10.6 score-points.

To further examine the extent to which these gaps explain pupil performance in mathematics, as with reading literacy, multilevel models for each cycle were conducted. Tables 8 and 9 present the models for 2009 and 2014 respectively. A comparison of the level-two variance in mathematics achievement in 2009 (ICC = 23.2%) and 2014 (ICC = 14.7%) indicated that, over time, there was a substantial decrease in the proportion of variance in pupils' mathematics performance that was explained by between-school differences. This finding is consistent with the pattern observed for reading and indicates that schools in NAMER differed substantially less than one another with respect to mathematics achievement in 2014 than in 2009.

In NAMER 2009, after accounting for the other variables included in the Step 2 multilevel model, pupil gender, books at home, parents' occupational status and schools' disadvantaged status were statistically significantly associated with pupils' mathematics achievement (Table 8). In particular, boys, pupils who had more than 100 books at home, those whose parents' occupational status was above the average, and who attended a non-DEIS school were expected, on average, to perform better than pupils in other groupings. Pupils' country of birth and language spoken at home were not statistically significant in the Step 1 and Step 2 models in Table 8. Schools' DEIS status was the strongest variable in the final model, with pupils attending DEIS schools

performing, on average, 20.9 score-points lower in mathematics than their peers attending non-DEIS schools. The examined factors included in the final model for mathematics 2009 (Step 2) explained 11.8% of the differences in pupil achievement.

TABLE 8

Multilevel Modelling of NAMER 2009 Mathematics Achievement

	Step 1 (comparison model)	Step 2 (final model)
Variables	*B (SE)*	*B (SE)*
Pupil-level		
Gender (male)	12.5 (2.66)*	12.2 (2.63)*
Country of birth (Ireland)	0.2 (3.24)	1.2 (3.47)
Language spoken at home (English/Irish)	-2.5 (4.49)	-2.2 (4.66)
Books at home (more than 100)	23.6 (2.84)*	18.5 (2.98)*
Parent occupational status (above average)	–	13.4 (2.19)*
School-level		
DEIS status (DEIS)	-20.1 (7.35)*	-20.9 (7.34)*
Intercept	243.0 (6.23)*	239.0 (6.84)*
Variance explained		
Pupil-level:	9.1%	11.0%
School-level:	13.8%	14.6%
Overall:	10.0%	11.8%

*$p < .05$.

As shown in Table 9, the results were somewhat different in the 2014 mathematics model. As well as pupil gender, books at home, and parents' level of education, language spoken at home was a (marginally) significant factor in the final model (Step 2). While bivariate analysis showed that there is no significant difference in mathematics achievement between pupils speaking English/Irish and pupils speaking another language at home, after accounting for socioeconomic and other background factors, pupils who speak a different language tended to perform significantly (albeit slightly) better in mathematics, by 9.6 score-points. In other words, if we had two pupils with a similar background, and they differ only in the language they speak at home, the pupil who speaks English or Irish at home would be expected to perform less well in mathematics than the pupil who speaks a different language. The opposite situation would be expected to hold in reading literacy, where pupils who speak English or Irish would be expected to do better by 12.1 score-points.

Parents' education was the strongest variable in explaining mathematics achievement in NAMER 2014. With other variables held constant, pupils with at least one parent who received some third-level education were expected to perform almost 16.5 score-points better than other pupils. After accounting for pupil background characteristics, DEIS status was no longer statistically significant. The final model explained 7.8% of the total variance in pupil mathematics achievement.

TABLE 9

Multilevel Modelling of NAMER 2014 Mathematics Achievement

	Step 1 (comparison model)	Step 2 (final model)
Variables	*B (SE)*	*B (SE)*
Pupil-level		
Gender (male)	4.9 (2.22)*	5.1 (2.20)*
Country of birth (Ireland)	1.0 (3.91)	2.6 (3.97)
Language spoken at home (English/Irish)	-8.2 (4.51)	-9.6 (4.65)*
Books at home (more than 100)	21.1 (2.19)*	15.9 (2.22)*
Parent education (third-level)	–	16.5 (2.16)*
School-level		
DEIS status (DEIS)	-5.3 (6.49)	-2.5 (6.47)
Intercept	261.6 (4.47)*	253.3 (4.41)*
Variance explained		
Pupil-level:	5.7%	8.7%
School-level:	2.0%	0.5%
Overall:	5.3%	7.8%

*$p < .05$.

A comparison of the Step 1 mathematics models for 2009 and 2014 shows that the variance explained by pupil and school factors was about half the magnitude in 2014 compared to 2009. In both cycles, gender and number of books at home were significantly related to mathematics achievement. However, in 2014, DEIS status, which was on its own associated with mathematics achievement, was no longer statistically significant after accounting for pupil-level variables. This, coupled with the smaller unadjusted DEIS/non-DEIS difference recorded in 2014 relative to 2009, further supports the conclusion that the inequalities attributed to the examined factors were somewhat smaller in 2014, after initial implementation of the National Literacy and Numeracy Strategy.

Interactions between gender and other pupil- and school-level variables were examined for the final mathematics models for both 2009 and 2014, but none of these interactions reached statistical significance, when corrections for multiple comparisons were applied.

Discussion and Conclusions

The aims of this study were to examine changes in 6th class pupils' performance in NAMER after the initial implementation of the National Literacy and Numeracy Strategy, and to investigate whether the observed changes were accompanied by improvements in equality. In other words, the study investigated the extent to which the variance in pupils' performance, as well as the performance gaps attributed to demographic and socioeconomic factors, changed after the introduction of the Strategy in 2011.

The results from the analysis of the relationships between background variables and pupil performance indicated that all examined groups of pupils saw improvements in both reading and mathematics. These improvements particularly favoured groups of pupils who had lower performance than their peers in NAMER 2009, leading to smaller performance gaps in NAMER 2014. These findings are consistent for reading and mathematics. However, greater improvements in equality were observed in mathematics achievement. This is demonstrated by the relevant effect sizes for descriptive statistics and the outcomes of the multilevel models, where the explained variance in mathematics achievement attributed to the examined demographic factors shrank by almost half after the implementation of the Strategy. According to Ferreira and Gignoux (2014), this result constitutes evidence of improved equality, as, after the initial implementation of the Strategy, pupils' performance was less 'dependent' on 'predetermined' factors. However, although the examined variables explained less of the variance in pupils' performance in 2014 than in 2009, it should also be acknowledged that some of the unexplained variance may be related to other factors not measured in NAMER: it should be noted that between 84% and 95% of the total variation in mathematics and reading achievement in 2009 and 2014 is unexplained by the models presented.

Another piece of evidence that complements this finding regarding improvements in equality is the substantially reduced variance that was attributed to between-school differences in 2014 compared to 2009. In 2009, 16.2% and 23.2% of the differences in pupils' performance in reading and mathematics, respectively, were attributed to the school that the pupils attended. These percentages were considerably lower in 2014 (ICC = 9.5% for reading; ICC = 14.7% for mathematics). The reduced ICCs indicate that pupils' performance in NAMER 2014 was less 'dependent' on the school they attended, suggesting that measures implemented by the Strategy helped reduce differences in performance attributable to school characteristics; pupils had better chances to perform well, independently of the school they attended.

It should be acknowledged, though, that in both reading and mathematics, most of the examined performance gaps remained statistically significant after the introduction of the Strategy, and that a relatively small, but statistically significant, proportion of the variance in pupil performance was still explained by some pupil and school background characteristics in NAMER 2014 (R^2 = 13.3% in reading; R^2 = 7.8% in mathematics). As explained earlier, these differences constitute evidence of inequality as they are attributed to 'predetermined' factors insofar as they do not necessarily reflect pupils' choices or actions (Ferreira & Gignoux, 2014). This indicates that, even though substantial progress has been made in bridging the performance gaps, there is still room for further improvements toward equality in outcomes. For example, the strength of the relationship between language spoken at home and pupils' reading performance has reduced over time, but the performance gap still remains statistically significant, favouring pupils who speak English or Irish.

Another interesting finding in the current study relates to the differences between pupils attending DEIS and non-DEIS schools. The performance gap between the two groups in mathematics was considerably reduced in NAMER 2014, as shown in the final models where, after accounting for other factors, DEIS status was significant in 2009 but not in 2014. This is a promising finding, where equality is concerned. However, the converse situation arises for reading literacy, where, after accounting for other variables included in the model, DEIS status was not significant in 2009, but was statistically significant in 2014. It should be noted that DEIS status in the current study comprised DEIS Band 1 and 2 schools combined (i.e., all DEIS urban primary schools), as well as DEIS rural schools. There may be value in looking at these variables separately in future models. It should also be borne in mind that while the samples for NAMER 2009 and 2014 are representative of the population of primary schools, they are not necessarily representative of the sub-population of DEIS schools, and so these findings should be interpreted with respect to random fluctuations in sampling error.

The outcomes reported here are broadly consistent with an earlier multilevel model exploring factors associated with reading achievement among 2nd class pupils in NAMER 2014 (Kavanagh et al., 2015). Even though Kavanagh and her colleagues did not explicitly examine changes in equality, they provided valuable evidence on 2nd class pupils' performance in reading and mathematics. After controlling for other variables in the model, their analysis showed that significant differences in reading achievement persisted between pupils in DEIS Band 1 schools compared with those in non-DEIS schools. Likewise, there was a difference of about one quarter of a standard deviation between pupils whose parents' highest level of education was Leaving Certificate or lower and those whose parents' highest level of education was a third-level degree or higher. All else being equal, pupils who spoke English or Irish at home had a mean score that was one-fifth of a standard deviation higher than those who spoke a different language at home. Higher numbers of books at home were associated with higher levels of reading achievement. The variables associated with 2nd class pupils' reading

performance reflect those identified by the current study as explanatory variables for 6th class reading performance. The between-school variance in reading achievement in the null model reported by Kavanagh et al. (9.4% for 2nd class) is about the same for 6th class in the current study (9.5%, 6th class).

Despite the small and non-significant gender differences associated with achievement on the descriptive statistics in the current study, gender was significant in the final model of reading in 2014, and in the final models of mathematics in both 2009 and 2014, when other variables were held constant. Unlike Kavanagh et al. (2015), the inclusion of gender in the models of reading literacy in the current study did not result in any significant gender interactions. This may be because Kavanagh et al.'s significant gender interactions involved pupil-level variables not considered in the current study (age, quality of school's communication with parents, and frequency of reading magazines and comics).

This paper has made several references to changes in performance and in equality arising from initial implementation of the National Literacy and Numeracy Strategy. The Strategy included a number of measures, including national targets in literacy and numeracy related to the National Assessments, increases in instructional time in English and mathematics, a requirement of schools to submit aggregated standardised test results to the Department of Education and Skills each year in respect of 2nd, 4th and 6th classes, a lengthening of teacher education programmes at primary and post-primary levels, additional resources for children in the most disadvantaged areas, and additional support for parents. As each of these, and other initiatives were implemented to varying degrees in the lead up to NAMER 2014 (see DES, 2017; Kavanagh et al., 2015), it is difficult to identify which specific initiatives contributed to the changes in equality documented in the current study. It is likely that a combination of factors contributed to the observed changes. As noted earlier, similar gains in achievement to those observed in this study were also seen in TIMSS 2015 (compared with TIMSS 2011) and in PIRLS 2016 (compared with PIRLS 2011), with such gains being more pronounced at the lower end of the achievement distribution. Hence, the changes in performance described in this paper are unlikely to be an artefact of the particular class levels involved in the National Assessments, or the particular tests administered to participating pupils.

The next series of national assessments, due to be administered in 2021, will provide evidence on the extent to which gains in performance and in equality observed in 2014 have endured and whether or not it has been possible to build on them.

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