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Leading and Learning

Left to their **own devices**

Trends in ICT at primary school level

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About the author

Dr Eemer Eivers is a Research Fellow at the Educational Research Centre, from where she led Ireland's participation in some of the world's largest educational studies, including PIRLS (Progress in International Reading Literacy Study), TIMSS (Trends in International Mathematics and Science Study) and PISA (Programme for International Student Assessment). She is an experienced developer of standardised assessments, and led the development of the Drumcondra Online Testing System, providing a new generation of *Drumcondra* tests to Irish schools.

Eemer has a particular interest in educational disadvantage, assisting the Department of Education in Northern Ireland with the implementation of their Literacy and Numeracy Strategy, and advising on the re-distribution of the Northern Irish education budget to include a greater focus on targeting disadvantage.

Since her career break in 2018, Eemer worked for the International Association for the Evaluation of Educational Achievement, where she advised on methods to reduce Malta's high rate of early school leaving. She is currently working with the National Foundation for Educational Research on England's report for the first International Early Learning and Child Well-being Study. This report was written in a personal capacity for IPPN.

Acknowledgements

This report is based on the outcomes of a number of large-scale and nationally representative studies conducted in Ireland between 2004 and 2016. Although I was the lead researcher in Ireland on most of the studies drawn on here, many others contributed to the work. I gratefully acknowledge the advice of various Irish stakeholder groups for each of the studies included, and the work of the many research and support staff in the Educational Research Centre, the International Association for the Evaluation of Educational Achievement, and the TIMSS and PIRLS International Study Center, all of whom contributed to the reports upon which these analyses are based.

I would like to acknowledge the ongoing and excellent levels of support from Irish principals, class teachers, parents and pupils for such studies. The level of cooperation in Ireland far exceeds international norms and makes the resultant reports a very accurate picture of the situation in Irish schools and homes.

The present report has been made possible by the support of the Irish Primary Principals' Network (IPPN). I gratefully acknowledge the interest and enthusiasm of a number of IPPN staff, but particularly Páiric Clerkin and Geraldine D'Arcy. They realised that the issues highlighted in IPPN's various membership surveys combined with the longitudinal data from large representative studies would provide a fuller picture than either of us could achieve independently.

List of Acronyms

DES	Department of Education and Skills
DOTS	Drumcondra Online Testing System
ERC	Educational Research Centre
ePIRLS	A test of online reading skills, part of PIRLS (see below)
ICT	Information and Communication Technologies
IPPN	Irish Primary Principals' Network
NA	National Assessments
NCCA	National Council for Curriculum and Assessment
PDST-TiE	Professional Development Service for Teachers - Technology in Education
PISA	Programme for International Student Assessment
PIRLS	Progress in International Reading Literacy Study
TIMSS	Trends in International Mathematics and Science Study
PT 2011	PIRLS and TIMSS 2011 (when both studies were jointly administered)

Origins

The genesis for this report came about in 2015 in a rural Wexford primary school which I was visiting as part of the "field trial" for a study called ePIRLS. Ireland had previously taken part in PIRLS (Progress in International Reading Literacy Study) but this was the first ever assessment of digital skills at primary level in Ireland. The Department of Education and Skills (DES) had just signed up for Ireland to take part in two international reading assessments – the traditional paper-and-pencil PIRLS test and the new digital ePIRLS test. The Educational Research Centre (ERC) was asked to run the studies in Ireland, and I was in charge of the implementation.

> *"Although billed as a test of "online reading skills" ePIRLS was actually delivered in a fake internet environment."*

Although billed as a test of "online reading skills" ePIRLS was actually delivered in a fake internet environment. The security of a closed and safe test environment and the fact that internet connectivity was not a requirement were no doubt factors in the decision to take part. Connectivity was a hot topic then, as the final set of post-primary schools had just benefited from the rollout of 100 Mbp/s, whereas many primary schools still had no reliable access at all. However, this new test didn't require connectivity and it could work on very basic computers. It seemed it might work in Ireland.

Unfortunately, by the time I headed to Wexford I was already aware of multiple technical and infrastructural problems. The most obvious issue was the absolute lack of computers in schools. Many schools had few or no functioning devices. Those that did have computers tended to have them dispersed across classrooms (often one antiquated desktop computer per teacher) and could not move them to a single room where pupils could be tested.

The "very basic" requirements were rarely met. Tablets and iPads were not suitable. Screens on Netbooks were too small. Operating systems had to be those that were still supported, but a surprising number of Irish primary schools were using out-of-date operating systems, leaving them open to all sorts of security risks. Many hard drives were cluttered with accumulated years of files and there was often too little capacity left to run our test. I'd learned that few schools could supply enough devices in a single room to test pupils, and for those that could do so, few of those devices were capable of running the test software.

The Wexford school was a shining exception. It had a computer room, a sizeable set of reasonably up-to-date devices, and a principal who was "into" ICT. My visit was to show him what the tests looked like and how to administer a test session. Each test was stored on a USB, so I inserted one, showed him where the test file was saved, and turned away from the screen for a few seconds. When I looked back, the file was gone.

We were both a bit confused, but I had some spare USBs so put another one in. We watched as the school's anti-virus software again deleted my file, which it had decided was "malware". A bit of subsequent research revealed that the school's anti-virus software was not very efficient at identifying malware. However, it was free and therefore very popular in Irish schools, including many schools we had identified as possibly capable of using their own devices. This meant we would have to ask teachers to turn off their school anti-virus software to install and run our tests, and then hope they remembered to turn the software back on again afterwards – what could possibly go wrong!?

The anti-virus software was the straw that broke this camel's back. I had been determined to use any available and suitable school devices, but this problem could not be safely overcome. We eventually field trialled a variety of delivery models for ePIRLS, but even before we began, we realised that providing laptops was probably the only reliable solution. And we were right. Many school computers failed at the last minute or stopped working in the middle of tests. Meanwhile my colleagues and I had collective nightmares about what might go wrong if a school's anti-virus software was left turned off. For the main study in 2016, all schools used external laptops supplied by the ERC. This was expensive, very complex to organise, and ate into teachers' time, but we had no choice.

I began to think back over the 20 years I'd been working with schools and wondered had ICT capacity improved at all. I realised I was one of the few people who could answer that question. Fast forward to 2018, when I contacted IPPN about an article for Leadership+. At that time, I was in charge of the rollout of a cloud-based assessment system called the *Drumcondra Online Testing System* (the DOTS). Because of their far better infrastructure, rollout began in post-primary schools, but in 2018 the DOTS tests had finally been standardised in primary schools. The long overdue new "Drumcondras" were nearly ready, and I wanted to let teachers know.

The original plan had been to provide new Drumcondras only on computer, but it very quickly became clear that this would exclude too many schools from access to modern tests. In the ERC we revised our plans and developed an equivalent set of tests that could be delivered on paper, computer, or a mixture of the two. My colleagues who managed the standardisation of the new primary level tests had incredible difficulties with the process, experiencing exactly the sort of issues I'd encountered with ePIRLS – with the added problem of poor internet connectivity. The DOTS was specifically designed so that each test taken used only minimal bandwidth, yet even the bare minimum was often unavailable.

Standardised tests must be standardised on a *nationally representative* and random sample of schools and pupils. However, many of the selected random sample of schools were not capable of cloud-based testing needed for the DOTS. To ensure that those selected could take part, the ERC had to supply either laptops or broadband or both to approximately half of the schools involved in the standardisation. While some schools had excellent ICT facilities, most did not, and some still had none. Over 400 laptops had to be hired to facilitate the standardisation. They also had to be safely transported to and from schools. Sets of laptops were moved around the country with almost military precision by my colleagues, matching schools' chosen test dates with the availability of laptops and technical support. Without revealing any commercially sensitive information, it obviously added hugely to the costs of developing new tests. It also represented a significant intrusion on teachers' time, and did not seem to me to be the most effective way to support ICT in schools.

It appeared that little had changed since my ePIRLS field trial and tribulations, despite the fact that the *Digital Strategy for Schools* (and the all-important associated funding) had been launched in the interim. All of this formed the backdrop to discussions with IPPN, the outcome of which is this report. The report uses data collected across multiple large-scale national and international studies, combined with issues highlighted in IPPN's various membership surveys, to see what, if anything, has changed in terms of ICT in primary schools over the past number of years.

> *While Ireland is the focus of the report, the international context is also important.*

1. Introduction

This report brings together research findings about the availability and use of Information and Communication Technology (ICT)[1] in Irish primary schools in recent years. It is framed in a broader context of national investment in ICT infrastructure in primary schools, and policy related to the use of ICT in classrooms over this period. The data presented here are from the most recent cycles of a number of very large national and international studies, and provide a nationally representative picture of the situation in Irish primary schools.

NOTE: The time period covered for this report largely predates some major documents, policies and curriculum changes. This includes the *Digital Strategy for Schools* (DES, 2015), the D*igital Learning Framework and Guidelines* (DES, 2017a, 2018), the *STEM Education Policy Statement and Implementation Plan* (DES, 2017b, 2017c).

The report is mainly based on data from successive cycles of the National Assessments and two large international studies of achievement: Progress in International Reading Literacy Study (PIRLS) and Trends in International Mathematics and Science Study (TIMSS). These major studies provide trend data, allow some international comparison, and – unlike other surveys of ICT resources – permit links between access to and use of ICT in the school, classroom, and home.

The report is divided into eight main sections. The first, this introduction, summarises the main data sources used for the report, while the second outlines key points related to funding and policy for ICT in Irish primary schools from 2000 to date. The third section looks at the availability of ICT in Irish schools and classrooms, while the fourth looks at availability in pupils' homes. Section five looks at how teachers and pupils use ICT in the classroom, while section six examines how parents and children use ICT at home. Section seven summarises the main findings on trends in ICT access and use, while the final section is a personal reflection on the findings and their implications for Irish primary schools.

While Ireland is the focus of the report, the international context is also important. Therefore, I use a set of "comparison countries" of particular interest to Irish readers, either because of linguistic or cultural similarities, high performance, or both. The selected comparison countries are Australia, England, Finland, Hong Kong, New Zealand, Northern Ireland, Russian Federation, Singapore, and United States. Some other countries are also referred to where especially noteworthy findings are observed.

The nature of this report is that it is descriptive and aimed at a general audience. For this reason, it does not include any reference to testing for statistical significance, and standard errors (a measure of the precision of an estimate) are not provided for the percentages reported.

Finally, the main aim of the report is to examine trends in availability and use of ICT in Irish schools, not to draw any conclusions about the relationship between ICT use and pupil achievement (e.g., performance on reading and mathematics tests). Snapshot studies such as those reported here are not designed to establish causal links between ICT availability or use and pupil achievement. While a frequently cited OECD report based on PISA[2] data found that "introducing digital technologies in schools has not resulted in the promised improved efficiency through better results at a lower cost" (OECD,

1 ICT as used here also encompasses 'digital technologies'.
2 PISA (Programme for International Student Assessment) examines reading, maths and science skills of 15-year olds in schools in OECD and partner countries. It is a snapshot study, run every three years.

2016, p. 85), the same report acknowledges that the right technology tools, in the right hands, used the right way, can make a difference.

Other research argues that the nature of ICT activity is more important than amount of time spent, that links between ICT usage and achievement can vary with age, that teacher competence in ICT usage is especially important, and that pupil characteristics (e.g., Special Educational Needs) matter (e.g., Maor, Currie, & Drewry, 2011; Wenglinsky, 2006). Specific to Ireland, Gilleece and Eivers (2018) note that the better availability of ICT resources in DEIS schools and the fact that those teaching pupils with Special Educational Needs often have priority access to ICT resources can make it difficult to disentangle the relationship between achievement and use.

In sum, the relationship between ICT and pupil achievement is complex, was not the main focus of any of the studies examined here, and is not considered in this report. More generally, however, technology is an inescapable aspect of life. Basic ICT skills are required for children to function effectively as citizens, so it is logical that schools have a role to play in fostering those skills.

INFORMATION ON DATA SOURCES

As noted, only one aspect of the studies cited is examined – ICT usage and access. More general information about pupil achievement or other variables examined in PIRLS, TIMSS and the National Assessments are available in the main national reports for the studies (Eivers, Gilleece & Delaney, 2017 [PIRLS 2016], Clerkin, Perkins & Cunningham, 2016 [TIMSS 2015], Shiel, Kavanagh & Millar, 2014; Kavanagh, Shiel, Gilleece, & Kiniry; 2015 [National Assessments 2014], Eivers & Clerkin, 2012 [PIRLS and TIMSS 2011], Eivers et al., 2010 [National Assessments 2009] and Eivers, Shiel, Perkins, & Cosgrove, 2005 [National Assessments 2004]).

In a number of places in this report, I refer to international averages from PIRLS and TIMSS 2011 (PT 2011), TIMSS 2015, and PIRLS 2016. The main comparison is between Irish data and each of these studies, not between studies. This is because the countries participating in different studies/cycles vary slightly, meaning that, although broadly comparable, study averages are not a like-for-like comparison.

NOTE: The information provided from the major national and international studies is at the *pupil* level. This is because they are designed to be representative of pupils, not of teachers or principals (in contrast to IPPN surveys, for example). For this reason, the sentence format "25% of pupils were taught by teachers who did X" is used, rather than "25% of teachers did X".

PIRLS

PIRLS is the largest international comparative assessment of reading achievement at primary school level. It is a project of the International Association for the Evaluation of Educational Achievement (IEA), assessing pupils in their fourth year of formal schooling (Mullis et al., 2017a). First run in 2001, PIRLS takes place every five years. Fifty countries took part in 2016, the most recent iteration of the study. Ireland took part in PIRLS in 2011 and 2016. More than 340,000 pupils, 330,000 parents, 16,000 teachers, and 12,000 schools took part in 2016, including over 4,600 Fourth class pupils in Ireland, along with their parents and teachers.

The 2016 cycle included a new element called ePIRLS, an assessment of online reading skills. Ireland was one of 14 countries that participated in both PIRLS and ePIRLS. As they use different modes of assessment and are designed to assess related, but different, skills, there is no overlap in test content between PIRLS and ePIRLS. The nature of test and questionnaire content evolves from cycle to cycle, and the countries that participate can also change. However, much of the content of questionnaires remains consistent, meaning that PIRLS provides us with trend and comparison information for a number of variables related to ICT.

In 2016, Irish pupils performed very well on PIRLS and ePIRLS (Eivers et al., 2017; Mullis et al., 2017a, 2017b). On PIRLS, only two countries – the Russian Federation and Singapore – of the 50 taking part had statistically significantly higher mean reading scores than Ireland. On ePIRLS, only Singapore significantly outperformed Ireland. As such, Irish pupils demonstrated very high levels of reading achievement in both a paper-based test and in an online environment.

TIMSS

TIMSS is another IEA project, assessing the mathematics and science skills of pupils. It has a primary and post-primary component, and takes place every four years. Ireland took part in the first cycle (in 1995) and in the two most recent cycles (2011 and 2015).

For the 2015 study, Ireland participated at both grade levels (Fourth Class and Second Year). In Ireland alone, more than 9,000 pupils and students took part, as did their parents and teachers. As with PIRLS, there are a number of questions shared between the 2011 and 2015 versions of TIMSS questionnaires – and indeed, shared with PIRLS 2016 questionnaires. As such, TIMSS also provides trend and comparison data related to ICT.

Primary pupils in Ireland performed reasonably well on TIMSS 2015. Of the 47 countries that took part, only seven achieved a mean mathematics score that was statistically significantly higher than Ireland, while 15 countries significantly outperformed Ireland on the science assessment.

“Irish pupils taking part in the 2014 National Assessments Study significantly outperformed their counterparts in 2009, at both grade levels and in both domains.”

National Assessments (NA)

The National Assessments (NA) are periodic evaluations of the English reading and mathematics skills of Irish primary pupils, and were first conducted in 1972. Originally, the assessment of reading and mathematics were conducted separately – in different years and on different pupil populations. However, in 2009, the study changed so that the same grades (and pupils) are now assessed on both reading and mathematics.

For the most recent cycle in 2014, over 8,000 Second and Sixth class pupils took part, as did their teachers and parents. Much of the content of the questionnaires used in 2009 was repeated in 2014, providing Irish trend data, but no international comparison. Some trend data are also available from NA 2004. Irish pupils taking part in the 2014 study significantly outperformed their counterparts in 2009, at both grade levels and in both domains.

Other sources

Three other sources are referred to as a backdrop to this report: the ICT Census conducted for the DES, the European Commission’s Survey of ICT in Education, and aspects of IPPN’s annual pre-conference surveys of membership. All three provide some limited longitudinal data, but all three suffer from the fact that they do not provide a representative sample of the population they claim to represent. This creates significant difficulties in the extent to which the resultant data can be seen as providing an accurate picture at national level.

In the case of the IPPN membership survey, the relative lack of representativeness is understandable. Each year, prior to the annual conference, members are asked to provide their views on a wide range of issues (including some questions related to ICT). The survey is primarily used to identify issues of particular interest to members, and to give a voice to members. It does not claim to be a nationally representative sample of all primary schools in Ireland, and the results are not published. It does, however, provide data about a large number of Irish primary schools and is occasionally referred to as a complement to the representative studies. IPPN provided the author with access to all data related to ICT from the surveys (IPPN, personal communication, March 11, 2019).

Regarding the ICT Census and the European Commission’s ICT survey (each outlined later in this section), both are *meant* to provide nationally representative pictures of ICT-related data. However, we cannot know if they do so as they suffer from poor to terrible response rates. This matters. If only a minority of those asked to take part do so, their views may not be representative of the population. For example, those who took part may be atypical in that they have a particular interest in ICT and have better than average facilities in their school, or they may have taken part because they wished to flag that their school facilities are very poor. Unfortunately, we cannot know which, if either, of these scenarios is true. All that can be said is that if you ask many teachers a question that relatively few answer,

those answers may not reflect the views of teachers, generally. The issue of vested interest applies less to the IPPN survey, as it encompasses a wide variety of topics, of which ICT is only one.

In contrast, response rates from parents, pupils, teachers and principals in various cycles of the National Assessments, PIRLS and TIMSS are excellent (e.g., 100% of class teachers in Ireland selected to take part in PIRLS 2016 completed a questionnaire). Thus, their answers can be considered to present an unbiased national picture.

ICT Census

On behalf of the DES, a census of all principals (primary and post-primary) took place in 2005 and 2013, examining ICT resources, infrastructure and use. In addition, a sample of teachers were asked to complete questionnaires. However, the surveys contain no information on computer availability or use in homes, nor do they examine pupil use of ICT in school, merely availability of infrastructure. Limited use is made of data from the 2013 census (Cosgrove et al., 2014) in the current report, as, while the census collected a large number of responses, participation rates were relatively poor, particularly amongst teachers (68% of principals but only 33% of teachers [rising to 47% after a second call for participation] responded).

European Commission's survey of ICT in schools

The Commission's survey of ICT in Education is an EU-wide survey of primary and post-primary school students, teachers and principals that took place in 2011/12 (European Schoolnet & University of Liège, 2013) and again in 2017/18 (European Commission, 2019). The surveys include plenty of content that is relevant to this report, including school ICT resources, internet speed, and parent and teacher self-reports of digital competence and confidence.

Unfortunately, while they were extensive surveys, they suffer from low participation rates in many countries, including Ireland. For example, almost 3,500 "invitations" were sent to principals of Irish primary and post-primary schools, asking for input from principals, teachers, parent and pupils to the most recent survey. However, only 54 primary teachers, 11 post-primary teachers, 140 students and 156 parents (across both levels) were interviewed.

2. Policies and funding related to ICT

This section summarises some of the more recent national policy initiatives and funding allocations related to ICT in primary schools. Table 1 highlights the main *policy* documents while Table 2 lists the main *funding* allocations and grants for ICT. Given the rapid obsolescence of most ICT hardware and the likelihood that older policy documents do not reflect the rapidly evolving nature of ICT, the summary focuses mainly on funding from 2004 to 2016. This broadly coincides with the studies considered in this report. The exceptions are the ICT in Schools Programme (which, while established in 1998, is still the main programme tasked with promoting digital literacy and ICT integration in teaching and learning) and Schools IT2000 (which led to the creation of the National Council for Technology Education, Scoilnet [a web portal for Irish education], and funding for some of the infrastructure found in schools in NA 2004).

POLICY DOCUMENTS

As much of the current primary curriculum dates from the start of the century, there is, not surprisingly, relatively little emphasis on ICT.[3] However, rapid technology developments since then meant the curriculum required supplementary policy documents and curriculum guidelines from the National Council for Curriculum and Assessment (NCCA). These focussed on the integration of ICT in teaching and learning (e.g., *Information and Communications Technology (ICT) in the Primary School Curriculum: Guidelines for Teachers*, 2004a*; Framework for ICT in Curriculum and Assessment*, 2007*)*, albeit without any significant additional funding allocations.

The *Guidelines for Teachers* included principles for effective use of ICT, as well as exemplars of classroom strategies using ICT and applications of using software, the internet, and other resources (NCCA, 2004a). The discussion paper *Curriculum Assessment and ICT in the Irish Context* (NCCA, 2004b) outlined a vision for ICT in curriculum and assessment, while the subsequent *ICT Framework* (NCCA, 2007) operationalised this vision, to try to support embedding ICT across the curriculum. The *ICT Framework* comprises four learning objectives (e.g., thinking critically and creatively) and associated learning outcomes, with the intent that pupils gain important knowledge and skills in ICT.

The next important document was the Inspectorate's evaluation of ICT usage in primary and post-primary schools (DES, 2008). Its key recommendations were that:

- improvements in ICT infrastructure should be prioritised at the classroom level (specifically, each classroom should have a computer and data projector for teacher use, and adequate broadband internet).
- the pupil-to-computer ratio should be reduced to 5:1 or less.
- a national ICT technical support and maintenance system should be introduced.

More generally, the Inspectorate's report recommended an increased emphasis on ICT across the continuum of teacher education, including greater emphasis on ICT during Initial Teacher Education (ITE) and an expansion of ICT-related Continuing Professional Development (CPD) opportunities. Finally, the report noted that

3 The Primary Language Curriculum released in 2016 includes digital media in its definitions of literacy and text (DES/NCCA, 2016). However, it will not have been experienced by pupils in any of the studies discussed, so is not relevant in this specific context.

schools often spent in excess of the allocated grants. In such cases, the funds allocated were not deemed adequate and had to be supplemented by fundraising activities.

More or less concurrently, an ICT strategy group was set up to advise on strategy and priorities for integrating ICT into teaching and learning across the curriculum. This was within the context of planned government investment of €252m in ICT (from the National Development Plan). The resultant report identified a number of investment priorities, including a national framework for ICT-related CPD, improved access to high quality software and digital content, supply and regular replacement of ICT equipment, high-speed school broadband access, and, provision of centrally-organised technical support and maintenance (Minister's Strategy Group, 2008). They also recommended that ICT be an integral part of ITE, not an add-on or curriculum module.

> "Subsequent to the Smart Schools report, a focus on ICT was included as part of the Teaching Council's review of Initial Teacher Education programmes."

The *Smart Schools = Smart Economy* report (Joint Advisory Group to the Minister for Education and Science, 2009) was published the following year and served as an action plan for ICT integration in schools. It reiterated the importance of continued development of ICT in schools, despite the significant economic difficulties at the time. The *Smart Schools* report made a number of recommendations organised around five key themes: classroom infrastructure; professional development; planning and multi-annual budgeting; digital content growth; and enhanced broadband access. The advisory group recommended an immediate investment of €150m to address ICT infrastructure deficits, followed by an annual allocation of €30m for support, replacement and enhancement. They also recommended increased centralisation of ICT expenditure (to reduce the variety of equipment used and to maximise economies of scale during procurement) and including technical support and maintenance costs in procurement.

Subsequent to the *Smart Schools* report, a focus on ICT was included as part of the Teaching Council's review of ITE programmes. On foot of the review, the Council recommended ICT in teaching as a mandatory area of study in ITE programmes (Teaching Council, 2011a), and explicitly recognised the role of new technologies and ICT in education (Teaching Council, 2011b). After *Smart Schools*, there was a slight lull in relevant policy developments, although the role of digital literacy featured within broader policies such as the *National Strategy to Improve Literacy and Numeracy among Children and Young People* 2011-2020 (DES, 2011), and *Better Outcomes, Brighter Futures: The National Policy Framework for Children and Young People* (Department of Children and Youth Affairs, 2014).

The next significant policy document was the *Digital Strategy for Schools 2015-2020* (DES, 2015), and subsequent *Digital Learning Framework and Action Plan* (DES, 2017a, d). The Strategy draws on the UNESCO ICT Competency Framework for Teachers (UNESCO and Microsoft, 2011), adapted to an Irish context. The development of the Strategy also involved consultation with education stakeholders and was informed by international best practice. It aims to advance progress of ICT in schools under four themes: teaching, learning and assessment using ICT; teacher professional learning; leadership, research and policy; and ICT infrastructure. The Digital Strategy is largely outside the scope of this paper, as it will not have influenced resources or practices in schools in the period up to spring 2016. It is, however, referred to in the final sections of this report, which discuss the findings and make some recommendations.

Although not a policy document, the role of the Professional Development Service for Teachers - Technology in Education (PDST-TiE) is also worth noting. In 2012, the role and functions of the National Centre for Technology in Education were integrated into the PDST. To support the Digital Strategy, their capacity has been significantly increased over the past few years. At the time of writing, the PDST-TiE were delivering a range of CPD programmes and other supports to schools, to help embed digital technologies in teaching and learning in schools. However, this will not be reflected in the studies summarised in this report.

Table 1: Summary timeline of key policy documents related to ICT in primary schools

Year	Document	Author
2004a	Information and Communications Technology (ICT) in the Primary School Curriculum. Guidelines for Teachers	NCCA
2004b	Curriculum, Assessment and ICT in the Irish Context: A Discussion Paper	NCCA
2007	ICT Framework: A Structured Approach to ICT in Curriculum and Assessment: Revised Framework	NCCA
2008	Investing Effectively in Information and Communications Technology in Schools 2008 - 2013	Minister's Strategy Group
2009	Smart Schools = Smart Economy	Joint Advisory Group to Minister for Education and Science
2011	Initial Teacher Education: Criteria and Guidelines for Programme Providers Policy Paper on the Continuum of Teacher Education	Teaching Council
2015	Digital Strategy for Schools 2015-2020	DES
2017a	Digital Learning Framework for Primary Schools	DES
2017d	Digital Strategy: Action Plan 2017	DES
2018	Digital Learning Planning Guidelines for Primary Schools	DES

This section mainly examines national funding for ICT up to 2016 – that is, funding and grants that *most or all* primary schools should have been able to access up to the point the studies presented here took place. It does not examine funding for new-build schools, as they represent a very small percentage of the more than 3,000 primary schools in Ireland. Similarly, it excludes funds under the "Minor Works" grants. ICT is only one (probably small) element of the many costs covered by the grant, and it is not possible to disaggregate ICT-related spending from other elements of the grant.

The period from 1999 to 2005 saw investment in ICT as part of Schools IT2000 and the *Blueprint for the Future of ICT in Irish Education* (DES, 2000) initiatives. The main aims of these programmes were to invest in infrastructure, ICT teacher training and development, and curriculum support (e.g., launch of Scoilnet). The Schools Broadband Programme 2005-2008 was a joint initiative between the DES and industry. It allocated €34.4m for the provision of broadband access to schools (Table 2). The funds were allocated to primary and post-primary schools, but it is unclear what proportion of the funds was allocated to primary level. The DES element of the funds was spread relatively evenly across the four years, but it has not been possible to establish the timeline for how the industry contribution was dispersed.

From 2005 to 2009, there were no other significant grant allocations for ICT other than a supplementary small-scale ICT grant issued to DEIS schools for the purchase of ICT equipment. In 2009, the ICT in Schools Programme was created in response to recommendations in the *ICT Strategy* and in *Smart Schools*. As a result of the programme, €92m was distributed to primary and post-primary schools between 2009 and 2010. Primary schools were allocated €22.3m in 2009 and €24m in 2010. The latter allocation comprised a lump sum of €1,700 plus €34.70 per capita, with DEIS schools each receiving an additional €840. The 2010 funds had to be spent on a prioritised basis. Each classroom had to be equipped with a computer, mouse and digital projector for the teacher. Only after these were purchased could schools purchase additional *equipment*, but not technical support.

Of the total funds allocated in 2009 and 2010, almost exactly half was allocated to primary schools. For context, at that time primary schools held almost 60% of the total school population and comprised approximately 80% of all schools (DES, 2012). The €92m provided by the ICT in Schools Programme fell well short of the recommended €150m outlined in *Smart Schools.* In addition, it allowed no funds for the annual allocation of €30m (for support, maintenance and replacement of infrastructure) recommended in *Smart Schools*.

Table 2: Main funding blocks related to ICT for schools, with amount allocated specifically to primary level identified, where possible

Year	Document	Total Amount	Amount primary level
2005-08	Schools Broadband Programme 2005-2008	€34.4m	
2009	ICT in Schools Programme (Equipment grant)	€22.3m	€22.3m
	Schools Broadband Access Programme	7.3m	
2010	ICT in Schools Programme (Equipment grant)	€70m	€24m
	Schools Broadband Access Programme	€5.9m	
2011	Schools Broadband Access Programme	€5.5m	
2012	Schools Broadband Access Programme	€6.3m	
2013	Schools Broadband Access Programme	€6.8m	
2014	Schools Broadband Access Programme	€9.2m	
2015	Schools Broadband Access Programme	€10.4m	€3.4m
2016	ICT Infrastructure Grant Scheme	€30m	€18.4m
	Broadband Access Programme	€15.2m	€5.0m

The table only shows funds disbursed to 2016, as this coincides with the analyses of availability and use of ICT in this report.

In 2012, the National Development Plan was superseded by the Capital Investment Plan, which prioritised school accommodation for capital investment. Other than maintenance of existing infrastructure related to the Schools' Broadband Access Programme, it allocated little or no funds for ICT infrastructure. This lack of investment was counter to the recommendations in various earlier policy documents about the need to supply ongoing funding to counter obsolescence, but was no doubt influenced by difficulties in the wider economic situation at the time. Obsolescence issues were also flagged in non-policy documents. For example, the DES (n.d.) submission for a capital investment programme indicated "an average life span of 5 years (at the outside)" (p.20) for ICT hardware and resources.

Between 2010 and 2016/17, there was no significant tranche of funds accessible for use *by schools*. Funding was mainly concentrated on rollout and maintenance of broadband (e.g. the School Broadband Access Programme), rather than the type of grant aid that allows schools to purchase ICT resources. Also, the rollout of broadband had a much stronger focus on post-primary than primary level. The High Speed 100 Mbps Broadband Programme was rolled out between 2012-2014 to all post-primary schools, but not to primary schools. While improved internet connectivity for primary schools is a priority under the Digital Strategy, any further rollout seems to be largely dependent on the National Broadband Plan, which has been beset by problems.

Thus, primary schools were typically unable to access funds to purchase ICT resources between 2010 and 2016/17. In the context of the studies described in the current report, this means that a sizeable proportion of equipment purchased under the 2010 grant might have been obsolete (using the criteria employed by the DES) by the time of the National Assessments 2014, most equipment was probably obsolete by TIMSS 2015 and almost all was likely to be obsolete by PIRLS 2016.

In contrast to the limited and somewhat sporadic funding made available to schools up to 2016, the Digital Strategy ICT infrastructure grant foresees a total of €210m to be allocated over a five-year period. Schools received €30m of this fund in 2016/2017 and again in 2017/18, with €45m allocated in 2018/19. As part of the grant, both primary and post-primary schools receive an annual lump sum of €2,000 and per capita amounts. In 2016/17 the per capita payments were €22.20 per primary pupil and €31.90 per post-primary student, rising to €39.89 (primary) and €50 (post-primary) in 2018/19. The scheme also provides for additional grants for pupils in Special and DEIS schools. However, funds must *only* be used to purchase ICT equipment or infrastructure, despite recommendations to the contrary from the ICT Strategy Group, the Inspectorate's 2008 report, and *Smart Schools*, and despite ongoing concerns

raised by representative bodies about the difficulties that many primary schools have in providing technical support and maintaining equipment (e.g., INTO, 2017; IPPN, 2015; Riley, 2015).

Part of the five-year allocation includes up to €5m per annum set aside to recognise schools' efforts to embed the use of digital technologies in teaching, learning and assessment. This is funding additional to the basic grant, and is available only to schools who apply and who can demonstrate how they have incorporated a digital learning plan into practice. The amount of funds received is on a per capita basis, dependent on the number of schools applying and qualifying. The per capita amount is the same for primary and post-primary schools, while fee-paying schools that apply can receive a 50% rate. Unfortunately, however, it seems possible that schools most in need of these additional resources might be those who are least likely to meet the criteria for accessing the additional funds.

"Part of the five-year allocation includes up to €5m per annum set aside to recognise schools' efforts to embed the use of digital technologies in teaching, learning and assessment."

In sum, three points of note emerge regarding funding of ICT. First, funding to schools to purchase ICT resources and improve infrastructure has been sporadic over the past decade, and has not matched the levels proposed under the *Smart Schools* (2009) report. While some funds were allocated to the Broadband Access Programme on an ongoing basis since 2005, these were to maintain infrastructure. They are distinct from grant aid that can be use by schools to purchase ICT resources. Thus, the funds associated with the Digital Strategy ICT infrastructure grant represent a welcome change. Second, funding that has been made available has focussed on devices and on infrastructure. The costs and difficulties associated with managing and maintaining ICT resources in a school have largely been ignored.

Third, while it is not always possible to disentangle the relative amounts allocated to primary and post-primary levels, it seems likely that primary schools have typically received slightly lower levels of resources. For example, the current ICT Infrastructure Grant is comprised of a lump sum (€2,000) and per-capita payments. While the lump sum is a flat rate, the per capita rate is higher at post-primary than at primary level. In the 2016/17 allocation, a school with an enrolment of 500 received a grant of approximately €11,000 if a primary school, and €15,000 if a post-primary school. For the 2018/19 year the respective amounts are €22,000 and €27,000. Another very significant difference is in broadband access. All post-primary schools have access to highspeed broadband of at least 100 Mbps, and have had so for a number of years. In contrast, a sizeable minority of primary schools continue to struggle to have *any* reliable access to the internet, yet no clear rationale has been provided for such a major difference in resourcing.

3. ICT resources in school

This section describes ICT resources in Irish schools and classrooms over recent years. It examines number of devices available, level of pupil access, principal and teacher perceptions about the adequacy of devices, staff technical competencies, and available support.

AVAILABILITY OF COMPUTERS

Each of PIRLS, TIMSS and the National Assessments report pupil:computer ratios (PCR). In the National Assessments, it is produced by dividing the total number of pupils in the school by the total number of available computers,[4] whereas TIMSS and PIRLS use a different calculation, which cannot therefore be directly compared with National Assessments data. Thus, Tables 3 and 4 present data on computer availability separately.

In NA 2004, principal reports indicate that the PCR was 16:1 for First class and 14:1 for Fifth class (Table 3). The ratio improved to a 12:1 ratio at Second and Sixth class in 2009, but deteriorated in 2014, to 14:1 for Second class and 15:1 for Sixth class. This is somewhat surprising, as the timing of the 2009 study pre-dated the large infrastructural grant provided by the DES in 2009 and 2010. Schools received funding for ICT in late 2009 and again in 2010, and the additional resources might have been expected to be reflected in the 2014 data, but this does not seem to be the case, perhaps because devices for teacher use were prioritised.

Table 3: Number of pupils per computer reported in NA 2004, 2009, 2014

	2004	2009	2014
1st class	15.6		
5th class	14.1		
2nd class		12.4	13.9
6th class		12.3	14.7

The two most recent National Assessments include a set of questions for teachers about access to various types of digital resources in the classroom. Somewhat surprisingly, there was a drop in the percentages of pupils for whom computers were available for use in their own classroom. In 2009, over three-quarters of Second (77%) and Sixth class (76%) pupils could access a computer in their own classroom, but by 2014 this had fallen to 68% of Second class pupils and 69% of Sixth class pupils. In 2014, only slightly more than one quarter of pupils were in schools with a central computer room, meaning that central rooms cannot adequately explain the drop in within-class availability. The data probably reflect the fact that the ICT in Schools Programme (in 2009 and 2010) largely targeted resources for teachers, not pupils, but it is nonetheless surprising that, at a time in which technology was becoming increasingly pervasive, pupil access in school decreased.

Both TIMSS and PIRLS also report PCRs, but the Irish data may be misleading as the calculation is based on the number of computers "available for use by Fourth class pupils", divided by the total number of Fourth class pupils. As computers in Irish schools are commonly shared between classes (e.g., laptop trolley, central room), many principals might consider all computers in the school as available for Fourth class. Thus, PCR calculated in this manner presents an inflated picture of computer resources available in Ireland. The same issue arises in some other countries where similar practice applies. For example, PIRLS 2016 data suggest that 57% of Irish pupils are in schools where there is a computer shared between one to two pupils. This is not only at odds with what anecdotal evidence would suggest to be true, but also clearly at odds with the reports from class teachers outlined later (in Table 8).

4 Despite using a whole-school calculation, the PCR differs by grade level because the NA include a small number of Junior schools and Senior schools.

Therefore, Table 4 shows the mean total number of computers available in Irish schools taking part in successive cycles of PIRLS and TIMSS. It also shows mean school enrolment in each cycle, as this is usually related to mean number of devices. As can be seen, there is a slight increase in mean school size (from 279 to 320[5]), as well as a more pronounced increase in the number of devices available (from 12 to 20).

Table 4: Mean number of computers available for use by Fourth class pupils in cycles of PIRLS and TIMSS and total mean school enrolment, PT 2011, TIMSS 2015 and PIRLS 2016

	Mean No. of Computers	Mean Enrolment
PT 2011	11.6	279.3
T 2015	17.8	302.5
P 2016	19.7	320.3

As well as number of computers, TIMSS and PIRLS asked principals if lack of computer technology for teaching and learning hampered instruction. In the years 2011-2016 there has been a marked increase in the percentages of Irish pupils in schools where lack of computer technology for teaching and learning is perceived to hamper instruction (Table 5). In 2011, roughly one-third of Irish pupils' principals expressed this view, rising to 43% in 2015 and 48% in 2016. In 2011, Irish principals were below the international study averages in perceiving shortage or inadequacy of computers for instruction as a problem. By 2015, they were slightly more likely than the international average to flag it as a problem, and by 2016, almost half of Irish pupils were in schools where principals flagged it as a problem, compared to a PIRLS average of 41%.

Table 5: Percentages of pupils whose principals indicated that their school's capacity to provide instruction is some or a lot hampered by shortage or inadequacy of computer technology for teaching and learning, PT 2011, TIMSS 2015 and PIRLS 2016

	2011	2015	2016
Ireland	34.	43.1	48.3
TIMSS	41.6	40.4	
PIRLS	41.3		40.7

The most recent National Assessment (2014) also provides evidence that principals are concerned by the lack of computers available for instruction. Then, the principals of 66% of pupils felt that shortage or inadequacy of computers for teaching was hindering teaching and learning either a lot or to some extent. Unfortunately, trend data are not available for this question.

eBOOKS

As digital and ebooks are a relatively recent phenomenon, they were not included in questionnaires until NA 2014. Then, across all schools, Second class pupils had access to an average of 17 ebooks in their school, while Sixth class pupils had access to an average of 15 ebooks. However, the average masks significant variability in access. A small number of schools had a large number of ebooks, while most had none. Principals' reports show that 79% of Second class and 80% of Sixth class pupils were in schools with no ebooks.

TIMSS 2015 asked principals about the number of digital books available in the school library, using number categories rather than an absolute value. In most cases (59%), the question was deemed not applicable in Ireland, due to the lack of a school library (Table 6), while 40% of pupils' principals chose the lowest response option (250 or fewer digital books). Only 1% of pupils in Ireland had access to more than 250 digital books in their school library, compared to a TIMSS average of 14% of pupils.

It is possible that the TIMSS data underestimate the availability of digital books in Irish schools, as most Irish schools have classroom libraries rather than a shared school library. However, PIRLS 2016 asked principals about access to digital books, generally. The data show little change from NA 2014. Only 19% of Irish pupils were in schools where they could access digital books, well below the international average of 41%. Some high access countries included Denmark, Sweden, and Kazakhstan, where over three-quarters of pupils could access digital books in school. In contrast, less than 4% of pupils in Germany, France, and the French-speaking part of Belgium were in schools where they had access to digital books.

5 This does not necessarily imply an increase in school size across the population of schools but rather an increase in the mean enrolment of the samples of schools that took part in these studies.

Table 6: Percentage of pupils whose principals indicated availability of digital books in Irish schools, in school library, TIMSS 2015

	250 or fewer	251-500	501+	N/A
Ireland	39.7	1.4	0.0	58.8
TIMSS	67.6	5.9	7.7	19.0

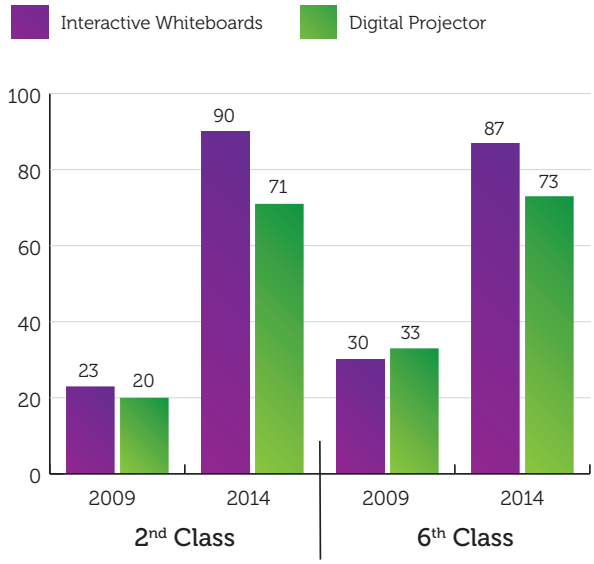
The PIRLS 2016 data show no clear pattern of access to ebooks, based on location. For example, schools in rural locations were at least as likely as those in urban and suburban locations to have some ebooks. Looking at DEIS status, access was lowest among DEIS rural schools (only 3% of pupils) and highest in DEIS Band 2 Urban (30%) and DEIS Band 1 Urban (21%). However, the number of DEIS schools in the study was relatively small, meaning that the measurement error around each percentage is relatively large, and the data should be interpreted with caution. Larger schools were slightly more likely to have some ebooks than were smaller schools, but differences were very small.

ANCILLARY RESOURCES

Between 2009 and 2014, National Assessments show very large increases in the percentage of pupils with interactive whiteboards in their classrooms – in contrast to the previously reported reduced in-class access to computers. There was an almost four-fold increase in availability at Second class (from 23% to 90% of pupils), and an increase from 30% of Sixth class pupils in 2009 to 87% in 2014 (Figure 1). Similarly, in-class access to digital projectors more than trebled among Second class pupils and more than doubled among Sixth class pupils. This reflects a key element of the 2009/10 funding for primary schools, which required that funds first be spent on a computer and digital projector for each teacher, with interactive whiteboards featuring as one of the subsequent priority purchases from any remaining funds.

In a related vein, the ICT Census 2013 reported high levels of access to whiteboards and digital projectors among *primary* teachers, with access to whiteboards considerably higher than for post-primary teachers (87% had access, compared to 30%) (Cosgrove et al., 2014). The first European Commission ICT survey also reported that Irish primary schools had one of the best ratios of whiteboards and projectors to pupils, whereas the ratio at post-primary was more or less average (European Schoolnet and University of Liège, 2013). The second

Figure 1: Percentages of pupils whose classrooms had interactive whiteboards and projectors, NA 2009 and 2014



European Commission survey (European Commission, 2019) also shows Ireland as having a slightly better than average access to whiteboards at primary level. However, as response rates for the second survey were particularly poor in Ireland, no data are presented for post-primary level, so a more recent primary / post-primary comparison cannot be drawn. Generally, caution is advised in interpreting any results from these studies, but they do broadly align with the outcomes reported in the National Assessments.

In TIMSS and PIRLS, principals were asked to report on the extent to which a shortage or inadequacy of ICT-related resources (including human resources) affected their school's capacity to provide instruction to pupils. The percentages of Irish pupils whose principal felt that instruction was *somewhat* or *a lot* hampered by shortages of technologically competent staff increased from 2011 to 2016 whereas the international study average dropped marginally. In 2011, 26% of Irish pupils' principals felt hampered (international average: 36%), rising to 32% in 2016 (international average: 35%) (Table 7).

There has been a noticeable change in Irish principals' views on the adequacy of audio-visual resources (e.g., interactive whiteboards and data projectors) since PT 2011. Then, principals of 42% of pupils felt resources

Table 7: Percentages of pupils whose principals indicated their school's capacity to provide instruction is somewhat *or* a lot *hampered by shortage or inadequacy of various digital resources, PT 2011, TIMSS 2015 and PIRLS 2016*

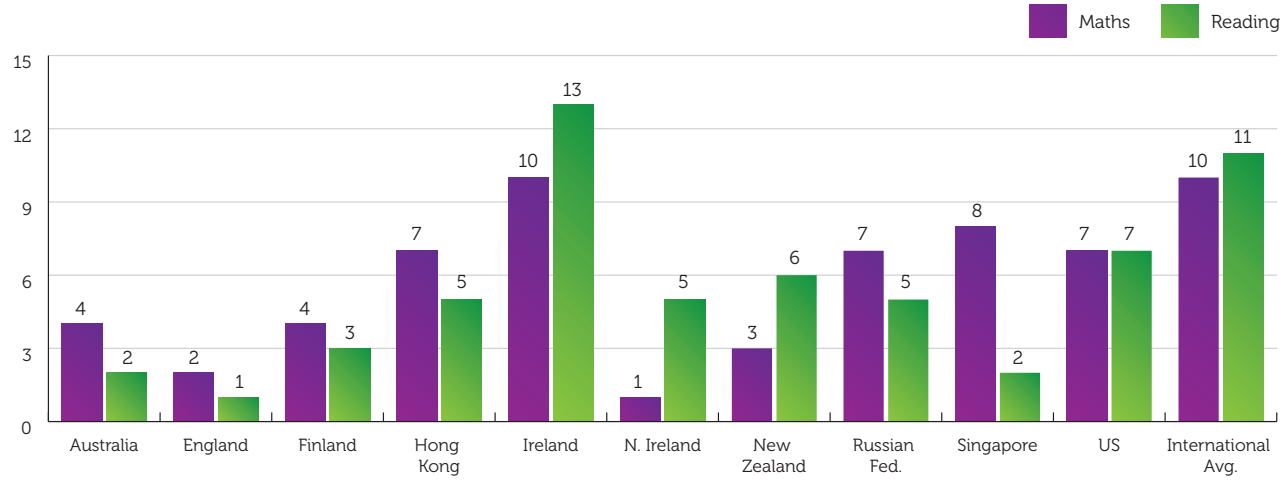
		2011	2015	2016
Technologically competent staff	Ireland	25.8	25.0	31.7
	TIMSS	35.5	34.0	
	PIRLS	36.3		35.1
Audio-visual resources (for maths/reading)	Ireland	40.4 /41.9	15.8	16.3
	TIMSS	39.3	35.0	
	PIRLS	38.8		35.6
Software for reading instruction	Ireland	37.1		43.2
	PIRLS	39.2		37.4
Software for maths instruction	Ireland	39.4	43.9	
	TIMSS	37.5	36.2	

were *somewhat* or *a lot* of a problem, close to the TIMSS and PIRLS study averages of 39%. However, by 2015 and 2016, only 16% of Irish pupils were in schools where the principal felt that inadequate audio-visual resources at least *somewhat* affected instruction, much lower than the TIMSS and PIRLS averages of 35% and 36%, respectively. The extent of change is surprising, given that most schools would have availed of the ICT equipment grant before PT 2011 took place, and were unlikely to have received much new equipment in the interim period. It may perhaps reflect an extended "bedding in" period with the technology purchased in 2010.

In 2011, well over one-third of Irish pupils' principals felt that inadequate software for reading and mathematics instruction was at least *somewhat* of a problem, broadly in line with the percentages for the international study averages. Internationally, the percentages dropped slightly for the subsequent study cycles. In contrast, the percentages increased in Ireland. For example, TIMSS 2015 data show that 44% of Irish pupils were in schools where the principal believed that lack of software for mathematics instruction hampered instruction. Similarly, in 2016, 43% were in schools where the principal felt issues with *reading* instruction software hampered instruction.

Looking only at Ireland and our selected *comparison countries* (see Introduction), Figure 2 shows the percentages of pupils whose principals indicated that a shortage or inadequacy of software for reading or maths instruction hampered instruction *a lot* (drawing on data from TIMSS 2015 and PIRLS 2016). As can be seen, no more than 5% of pupils in Australia, England, Finland and Northern Ireland were in schools where the principal perceived a lack of either mathematics or reading software as a serious issue. Perhaps of particular interest are the low percentages in England and in Northern Ireland. For example, only 1% of pupils' principals in Northern Ireland perceived a shortage of mathematics software as hampering instruction *a lot*, while in England, no more than 2% were in schools where shortages in either reading or mathematics software was perceived as a serious issue. In contrast, Ireland is the only country among the selected comparison countries where at least one in ten pupils is in a school where shortage of software for each subject is perceived to hamper instruction *a lot*.

Figure 2: Percentages of pupils whose principals indicated that their school's capacity to provide instruction was hampered a lot by shortage or inadequacy of software for reading or maths instruction, TIMSS 2015 and PIRLS 2016, Ireland and comparison countries



Somewhat related data are available from NA 2014. Then, just over two-thirds of Irish pupils (68%) were in schools where the principals felt teaching and learning was hindered *a lot* or *to some extent* by shortage or inadequacy of teaching software, curriculum area unspecified. IPPN's pre-conference surveys also contain some pertinent information (subject to the aforementioned issues of representativeness). The 2016 and 2017 IPPN surveys both found that language and mathematics were the two areas where digital software was most likely to be used to support the curriculum. Thus, the fact that so many Irish principals taking part in PIRLS and TIMSS felt there were issues with software in these two key areas is worrying.

The quality of software that can be accessed may in part be related to connectivity issues. Neither PIRLS nor TIMSS asked principals about connectivity issues, but in NA 2014, 67% of principals felt teaching and learning was hindered *a lot* or *to some extent* by slow internet speed. Again, the IPPN pre-conference surveys offer supporting evidence that connectivity is an issue in many schools. As recently as 2018, 34% of IPPN members reported that their school did *not* have a reliable and adequate internet connection, while data from the 2016 and 2017 surveys show that approximately 40% indicated that their school's ICT resources for pupils were either not functioning or only partially functioning (data supplied by IPPN, March 11, 2019). In a related vein, more than half of respondents indicated that their school's ICT facilities were not being used by *all* pupils. This may in part be attributable to problems in providing access for large numbers of pupils.

PUPIL ACCESS TO ICT

Each of PT 2011, TIMSS 2015 and PIRLS 2016 asked teachers if their pupils had computers available for use during their (reading or mathematics) lessons. Although the question gives no indication of the *number* of computers available, it does provide a directly comparable indicator over a 5-year period in Irish schools. Figure 3 looks at Ireland and a set of comparison countries who took part in both cycles. It shows the percentages of pupils who had *at least some access* to a computer during reading lessons.

As can be seen, Irish pupils' access to computers has dropped in the period 2011-16. While 56% had access to computers for reading lessons in 2011, by 2016 this had fallen to only 39%. In five countries (England, Finland, New Zealand, Northern Ireland, Russian Federation), access increased since 2011, whereas Ireland was one of five where access decreased. However, the percentage drop in Ireland was larger than in any of the other four countries (Australia, Hong Kong, Singapore, United States) where access had decreased since 2011.

The percentage of Irish pupils with access to computers for reading lessons in 2016 was not only lower than the PIRLS average, but fell well short of access in countries such as New Zealand and Denmark, where more than nine in ten pupils could access a computer during reading lessons. Among our comparison countries, only pupils in Hong Kong had lower access to computers in reading lessons (although TIMSS 2015 data show that pupils in Hong Kong had better access to computers for mathematics lessons [45%]).

Figure 3: Percentages of pupils whose teachers reported that pupils had a computer available for reading lessons, Ireland and comparison countries

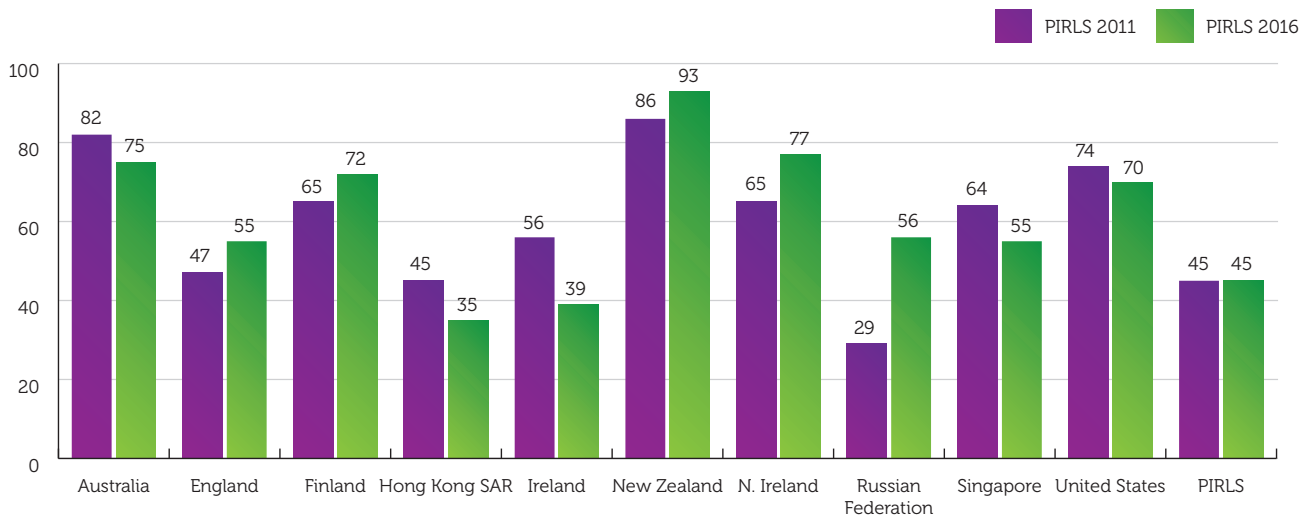


Table 8: Percentages of pupils with various types of access to computing devices during reading or maths lessons, PT 2011, TIMSS 2015, PIRLS 2016

		Each pupil has a computer	Class has shared computers	School has shared computers	No access
2011	Ireland PIRLS TIMSS				44.5 55.5 58.2
2015	Ireland TIMSS	2.5 6.9	24.6 20.4	28.8 31.1	60.0 62.4
2016	Ireland PIRLS	2.5 10.3	18.0 24.0	33.1 37.4	61.8 55.1

PIRLS 2016 and TIMSS 2015 included a related question about the level of access to computers during maths or reading lessons. Teacher reports indicate that only 2% of Irish pupils had their own device (Table 8). Irish access falls well behind access in countries such as Sweden, Denmark, United States, Georgia, Kazakhstan, and Singapore, where at least 20% of pupils had one-to-one access to a computer in PIRLS 2016. Amongst countries with high levels of pupil access, some had centrally supplied devices, while others supplemented school-owned devices with a BYOD (Bring Your Own Device) policy. However, apart from the small number of high access countries, Irish access is also well below the overall international averages reported in TIMSS 2015 (7%) and PIRLS 2016 (10%).

Between 2015 and 2016, the percentage of Irish pupils with access to shared classroom computers fell from 25% to 18%, somewhat offset by a smaller increase in those with access to shared school computers.

The final column of Table 8 also shows the reverse of some of the data in Figure 3 – the percentages of pupils who did not have any access to a computer during reading or mathematics lessons. In Ireland, the percentages with no access to computers has steadily increased since 2011, from 44% to 60% in 2015 and 62% in 2016. Ireland's position has thus switched from having fewer pupils than the international average with no access to having more pupils than average with no access.

4. ICT resources in the home

TIMSS, PIRLS and the National Assessments all ask questions about ICT resources in the home. Unlike schools, Irish pupils' homes were characterised by high levels of access to ICT and digital devices, exceeding international averages (Table 9). In both 2015 and 2016, fewer than a half a percent of Irish pupils' homes had no digital devices, compared to international averages of almost 5%. The modal category for Ireland was 4 to 6 devices in the house (just over 40% of homes), while over 10% of pupils in both 2015 and 2016 had at least 11 devices, marginally higher than corresponding international averages.

As with school-based resources, there was considerable variation by country. For example, just over 40% of pupils in Morocco had no digital devices at home, whereas more than 20% of pupils in Denmark, Norway and Sweden had at least 11 devices at home.

COMPUTERS

Access to digital devices in Irish homes is not a recent phenomenon. Since the question was first included in NA 2004, a large majority of pupils were reported to have home access to computers (Table 10). Then, parental reports indicated high access (almost two-thirds of First class and three-quarters of Fifth class pupils), even though the question asked was quite restrictive (if their child had access to a computer *for educational purposes*). In NA 2009, 89% of Second class and 96% of Sixth class pupils reported that they had a computer at home, almost identical to the 96% of pupils in PT 2011 and PIRLS 2016.

TIMSS 2015 asked a slightly different question – about pupils having their own computer and having access to a shared one. Irish pupils were far more likely than the TIMSS average to have their own device (80% versus 66%, respectively). Only five of the 47 participating TIMSS countries (Cyprus, Denmark, Kuwait, Northern Ireland and Norway) had higher percentages of pupils with access to their own device. More generally, data from PT 2011, TIMSS 2015 and PIRLS 2016 show almost universal access to a computer in Irish homes, and access levels in each cycle above the international averages.

Table 9: Parent reports of percentages of pupils' homes with various numbers of digital devices, TIMSS 2015, PIRLS 2016

		None	1-3	4-6	7-10	11+
2015	Ireland	0.2	18.4	41.5	29.4	10.4
	TIMSS	4.4	29.2	35.8	21.3	9.3
2016	Ireland	0.3	18.1	41.1	30.0	10.4
	PIRLS	4.7	29.6	35.7	21.6	8.5

Table 10: Percentages of pupils in Ireland who had various types of computer access in their home, NA 2004 and 2009, PT 2011, TIMSS 2015 and PIRLS 2016

			%
A computer for pupil to use for educational purposes	NA 2004	1st class 5th class	64.5 73.8
A computer	NA 2009	2nd class 6th class	88.7 95.7
A computer	PT 2011	Ireland PT	96.0 86.1
A computer or tablet of your own	T 2015	Ireland TIMSS	80.1 66.3
A shared computer or tablet	T 2015	Ireland TIMSS	67.9 70.6
A computer or tablet	P 2016	Ireland PIRLS	96.5 91.5

INTERNET ACCESS

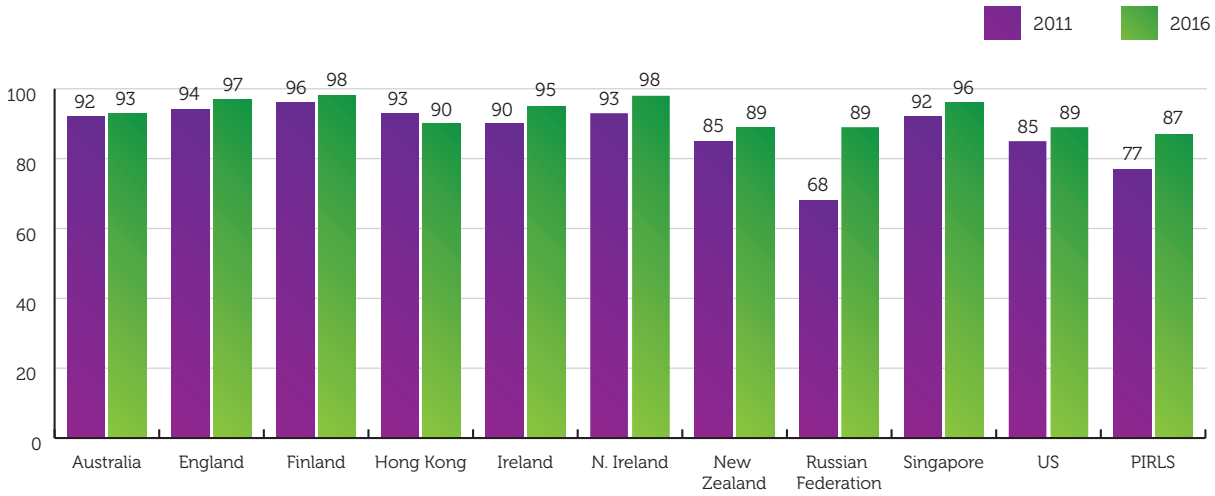
PIRLS and TIMSS ask pupils about the availability of internet access in their home, while the two most recent National Assessments enquired specifically about broadband internet access. As far back as 2004, close to half of Irish pupils had internet access at home (Table 11). As was the case with computers, pupils in senior classes were more likely to have access than were pupils in junior classes. By NA 2009, there was a marked increase in access, with at least three-quarters of pupils having *broadband* internet access. In contrast, the increase in access to broadband between 2009 and 2014 was relatively small (only a 3% to 6% increase, depending on grade level). However, PIRLS and TIMSS data show that basic internet continued to increase, from 90% of Irish pupils in 2011 to 95% in 2016.

Home access to internet in Ireland also remained above the international study averages in each of the 2011, 2015 and 2016 cycles. For example, 90% of Irish pupils had home access to internet in 2011 (international average: 77%), rising to 95% by 2016 (international average: 87%). However, access in Ireland remains slightly below the almost universal availability in Norway, Sweden, Denmark, Finland and Northern Ireland. Among Ireland's comparison countries, the largest increase in internet access was apparent in the Russian Federation (from 68% to 89% of pupils' homes), with all countries other than Hong Kong showing a slight increase in access between 2011 and 2016 (Figure 4).

Table 11. Percentages of pupils who had internet or broadband internet access, NA 2004 and 2009, PT 2011, TIMSS 2015 and PIRLS 2016

			%
Internet	NA 2004	1st class 5th class	41.6 55.1
Broadband internet	NA 2009	2nd class 6th class	76.9 83.8
Internet	PT 2011	Ireland P&T	90.3 76.9
Broadband internet	NA 2014	2nd class 6th class	82.5 87.7
Internet	T 2015	Ireland TIMSS	92.3 81.5
Internet	P 2016	Ireland PIRLS	95.4 86.8

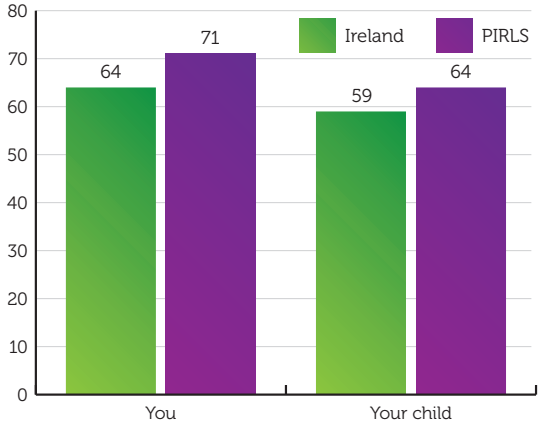
Figure 4. Percentages of pupils who had home internet access, Ireland and comparison countries, PIRLS 2011 and 2016



eBOOKS

PIRLS 2016 included a new question, in which parents were asked if they and their child had a device for reading ebooks. A majority of pupils' parents reported that they and their child could access a device for reading ebooks, but access was slightly lower in Ireland than the PIRLS average (e.g., 64% of Irish parents versus 71% of parents, internationally) (Figure 5). This contrasts with Irish home access to *printed* books, which is consistently above international averages across cycles of PIRLS and TIMSS. That aside, Irish pupils had much higher levels of access to a device for reading ebooks at home than they had in school.

Figure 5: Percentages of pupils whose parents reported that they or their child had access to a device for reading ebooks, PIRLS 2016



5. Use of ICT in the classroom

This section looks at the use of ICT in classrooms by teachers and pupils. This includes teacher use for planning lessons and as part of instruction, and factors that may influence teachers' adoption of ICT, such as experience, confidence, and the availability of support. Pupil engagement with ICT is examined, as is ICT-related self-efficacy.

USE OF ICT FOR PLANNING AND PREPARATION

Both NA 2009 and NA 2014 asked teachers about planning English and mathematics lessons. However, the format of the questions differed, meaning caution must be exercised in comparing results across the two studies. In NA 2009, the question was open-ended (teachers were asked to list the three main resources they had used in the last week). Then, 40% of Second class pupils were taught by a teacher who used material from the internet for planning English lessons, compared to 28% for mathematics lessons. Similarly, at Sixth class, use of the internet to plan English lessons was more common than for mathematics (62% versus 33%, respectively).

In contrast, in 2014, teachers were explicitly asked how often they used the internet to plan either English lessons (if teaching Second class) or mathematics lessons (if teaching Sixth class). Roughly half (52%) of Second and Sixth class pupils were taught by a teacher who reported using the internet *at least weekly* to plan lessons. This suggests that there may have been an increase in the use of the internet to plan lessons, subject to the caution about the different format of the questions asked.

Trend data on the use of ICT for planning are unavailable for PIRLS and TIMSS, as only the 2011 cycle included a question on the topic. Then, almost all Irish pupils were taught by teachers who used computers to prepare lessons (96% versus PT 2011 average of 85%) and for administration (85% versus PT 2011 average of 76%). However, the question did not specify using the internet, specifically, so the responses are likely to include various digital activities, such as creating a pupil worksheet or typing notes.

USE OF ICT FOR INSTRUCTIONAL PURPOSES

Both PT 2011 and the National Assessments asked teachers about their use of computers in lessons, but again, the questions are not directly comparable. In PT 2011, 98% of Irish pupils were taught by teachers who used computers for classroom instruction, much higher than the PT 2011 average of 74%. However, no indication was given as to frequency of use, or use in which lessons. In contrast, NA 2009 and 2014 asked about frequency of use, specific to English and mathematics lessons.

In NA 2009, approximately one-quarter of pupils in Second class were taught by a teacher who used computers in English and mathematics lessons on at least a weekly basis, while almost half rarely or never used computers in their lessons (Table 12). At Sixth class, use of computers was more common for English than for mathematics lessons. Only 14% of Sixth class pupils were taught by teachers who used computers in mathematics lessons on a weekly basis (half never did so). For English lessons, almost one-quarter of pupils' teachers used computers at least weekly, while 30% rarely or never did so.

Table 12: Percentages of pupils whose teachers indicated using computers in lessons, with varying degrees of frequency, NA 2009

		At least once a week	Once or twice a month	Rarely or Never
2nd class	English	25.5	32.9	41.6
	Maths	24.4	28.7	47.0
6th class	English	23.0	46.8	30.2
	Maths	14.5	36.0	49.5

As part of the 2014 National Assessments, teachers were also asked to indicate how often they used computers in their lessons, but distinguishing between use by the teacher and by the pupil. Also, Second class teachers were asked to answer with regard to computer use in English lessons only, and Sixth class teachers with regard to mathematics lessons only. A majority of pupils were taught by a teacher who used computers in lessons *at least weekly* (77% of Second class pupils for English, and 70% of Sixth class pupils for mathematics) (Table 13). However, pupil use was far less common. Only 24% of Second class pupils and 29% of Sixth class used computers in English and mathematics lessons on an at least weekly basis, while at least 40% rarely or never did so.

The 2009 and 2014 National Assessments included questions on how often teachers used interactive whiteboards and digital projectors. In 2009, between 68-75% of pupils were in classes where their teacher rarely or never used an interactive whiteboard as part of classroom lessons (Table 14). However, by 2014 only 14-16% of pupils were taught by a teacher who rarely or never used a whiteboard, whereas roughly half were in classes where a whiteboard was used for most or all lessons. Teacher use of digital projectors in 2009 was also a relatively rare classroom practice, with 71-85% of pupils taught by a teacher who rarely or never used this in lessons, whereas the corresponding percentages (36-39%) in 2014 were much lower. The very large increase in use of whiteboard and digital projectors reflects the very large increase in their availability within classrooms over the same time frame (as outlined earlier).

Table 13: Percentages of pupils whose teachers reported computer use in lessons by teacher and by pupil, NA 2014

			At least once a week	Once or twice a month	Rarely or Never
Teacher	English	2nd class	77.2	13.5	9.3
	Maths	6th class	69.9	17.9	12.2
Pupil	English	2nd class	24.2	35.8	40.0
	Maths	6th class	29.2	28.6	42.2

Table 14: Percentages of pupils, by teachers' use of interactive whiteboard and digital projector in English and Mathematics lessons, NA 2009 and NA 2014

				Most/all lessons	1/2 a week	Rarely or Never
Whiteboard	NA 2009	English	2nd class	13.9	5.8	74.0
			6th class	14.3	13.3	68.5
		Maths	2nd class	13.5	5.6	74.5
			6th class	16.2	9.4	68.0
	NA 2014	English	2nd class	47.1	31.1	14.2
		Maths	6th class	50.8	26.2	16.2
Projector	NA 2009	English	2nd class	3.7	4.4	80.0
			6th class	3.3	11.8	71.1
		Maths	2nd class	2.7	5.2	85.0
			6th class	4.5	6.6	79.2
	NA 2014	English	2nd class	26.9	27.8	35.5
		Maths	6th class	35.1	16.3	38.9

Note: The option "Once or twice a month" is not shown in the table, meaning responses do not sum to 100%.

Table 15: Percentages of pupils whose teachers used software and the internet in English and mathematics lessons, NA 2014

			At least once a week	Once or twice a month	Rarely or Never
Software to teach	English	2nd class	22.9	33.7	43.4
	Maths	6th class	32.5	30.7	37.0
Internet to teach lessons	English	2nd class	40.2	39.4	20.4
	Maths	6th class	38.1	35.3	26.6

NA 2014 also included some questions about using software and the internet to teach lessons. Software was used to a lesser extent than the internet, especially at Second class. Only 23% of Second class pupils' teachers used software to teach English on an at least weekly basis, compared to 40% who used the internet to teach English lessons on an at least weekly basis (Table 15). One-third of Sixth class pupils' teachers used software to teach mathematics lessons on an at least weekly basis, compared to 38% for internet use in lessons. Regarding internet use, pupils at both class levels were more likely to be taught by a teacher who regularly used the internet for lesson planning (approximately 52%) than for lesson delivery (approximately 40%).

ACTIVITIES SPECIFIC TO READING INSTRUCTION

As part of PIRLS, teachers were asked to provide information about the frequency with which pupils engaged in various computer-related activities in reading lessons. A substantial percentage of Irish pupils were taught by teachers for whom ICT use for instructional or learning purposes as part of reading lessons was *not applicable*, due to lack of availability of computers for use (approximately 45% of pupils in PT 2011 and 62% of pupils in PIRLS 2016). In terms of trends, the percentage of Irish pupils whose teachers indicated that pupils in their class had access to a computer as part of lessons was above the PIRLS average in 2011 but below the PIRLS average in 2016 (Table 16).

Table 16: Percentages of pupils whose teachers use ICT to develop various skills in reading lessons, PIRLS 2011 and 2016

			At least weekly	Monthly	Rarely or Never	Not applicable*
Develop reading skills and strategies with instructional software	2011	IRL	11.7	18.2	25.0	45.1
		PIRLS	13.8	15.1	15.1	56.0
Have pupils look up information	IRL	2011	24.6	25.3	5.2	44.9
		2016	21.4	15.3	1.6	61.8
	PIRLS	2011	20.8	17.2	6.0	55.9
		2016	25.8	16.5	2.3	55.4
Have pupils read digital texts	IRL	2011	21.9	20.3	12.9	44.9
		2016	13.8	13.2	11.2	61.8
	PIRLS	2011	14.5	18.0	11.5	56.0
		2016	19.4	17.0	8.2	55.4
Have pupils write stories	IRL	2011	10.5	32.4	12.1	44.9
		2016	11.3	19.8	7.1	61.8
	PIRLS	2011	13.1	19.2	11.8	56.0
		2016	17.7	20.1	6.8	55.4
Teach strategies for reading digital texts	2016	IRL	9.7	10.6	17.9	61.8
		PIRLS	13.0	17.7	13.9	55.4
Teach pupils to be critical when reading on the internet	2016	IRL	11.4	16.7	10.1	61.8
		PIRLS	17.2	20.6	6.7	55.4
Have pupils research a particular topic or problem	2016	IRL	16.7	20.2	1.4	61.8
		PIRLS	19.6	20.6	4.4	55.4

** Not applicable in this instance means that computers were not available for pupils to use in their reading lessons.*

Figure 6: Percentages of Irish pupils whose teachers use ICT to develop various skills in reading lessons on an at least weekly basis, by teacher experience, PIRLS 2016

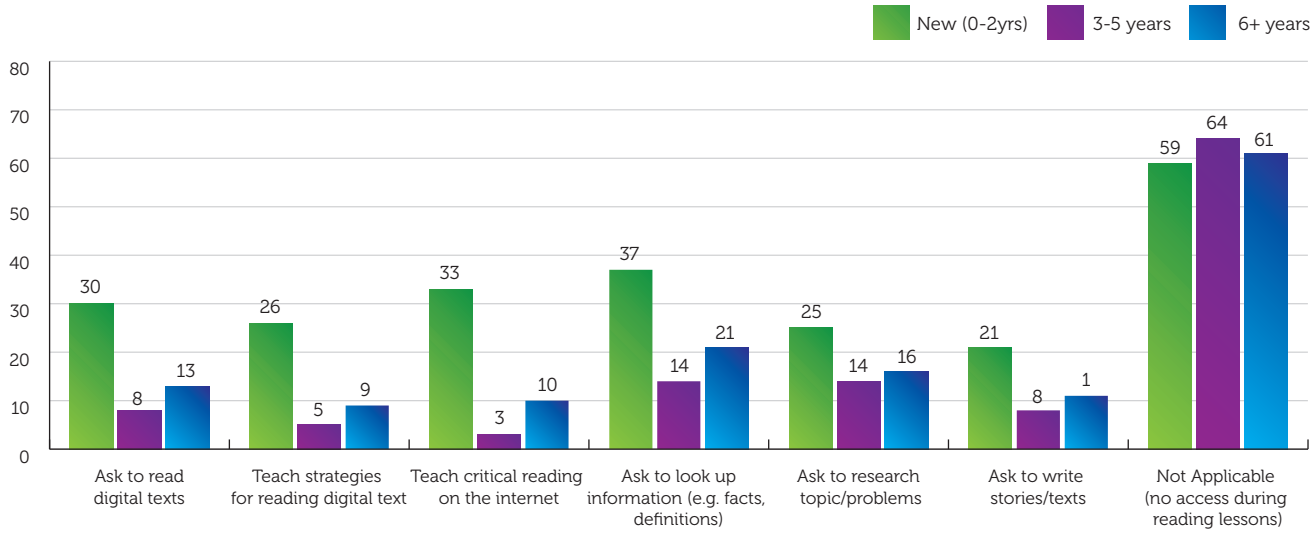


Table 16 shows teacher responses to questions included in one or both of PIRLS 2011 and 2016 about reading lesson activities. In 2011, teacher reports suggest that only 12% of Irish pupils regularly developed reading skills and strategies with instructional software, and that 25% rarely or never did so, higher than the 15%, internationally, who rarely or never did so.

The next three questions were asked in both 2011 and 2016. In that time period, the percentage of Irish pupils who used computers *at least weekly* to look up information dropped slightly from 25% to 21%, whereas the PIRLS average increased slightly from 21% to 26% of pupils. Similarly, the percentages of Irish pupils whose teacher got them to read digital texts *at least weekly* dropped by 8%, while the PIRLS average increased by 5% over the same period. Using computers to write stories remained a relatively uncommon activity in Ireland (approximately 11%) whereas 18% of pupils, internationally, did so *at least weekly* in 2016.

The final three questions were asked in 2016 only. Then, only 10% of Irish pupils were taught strategies for reading digital texts on an at least weekly basis (PIRLS average: 13%) and only 11% were taught on a weekly basis to be critical when reading on the internet (PIRLS average: 17%). In addition, 10% of Irish pupils were taught by teachers who indicated that they *rarely or never* taught pupils to be critical when reading the internet (PIRLS average: 7%). In contrast, having pupils research a particular topic or problem was a more common activity, in Ireland and across PIRLS as a whole. Only 1% of pupils in Ireland (PIRLS average: 4%) *rarely or never* did so.

Looking at the questions asked in 2016, there is a clear relationship between years of teaching experience and frequency of use of computers in reading lessons. That is, new teachers (defined as having less than two years' experience) were far more likely than all other teachers to make use of ICT in reading lessons for a variety of purposes, although it remained the case that a majority of teachers in all categories did not have access to computers in reading lessons (Figure 6). For example, 33% of pupils taught by new teachers were regularly (*at least weekly*) taught to be critical of what they read on the internet, compared to only 3% of pupils taught by teachers with moderate levels of experience. Pupils taught by new teachers were also far more likely to be asked to read digital texts and to look up information on the internet.

Figure 7 presents similar data, but split by teacher gender. While teaching experience seems to be a factor in use of ICT in reading lessons, gender seems to exert less of an influence on instruction. Female teachers were slightly more likely to use ICT *at least weekly* to teach strategies for reading digital texts (11% of pupils versus 5% of pupils taught by male teachers) and to ask pupils to write stories (13% of pupils, versus 7% of pupils taught by a male teacher). In contrast, pupils taught by male teachers were slightly more likely to be asked to look up information (23% versus 21%) and research topics (19% versus 16%), but differences were generally quite small.

Figure 7: Percentages of Irish pupils whose teachers use ICT to develop various skills in reading lessons on an at least weekly basis, by teacher gender, PIRLS 2016

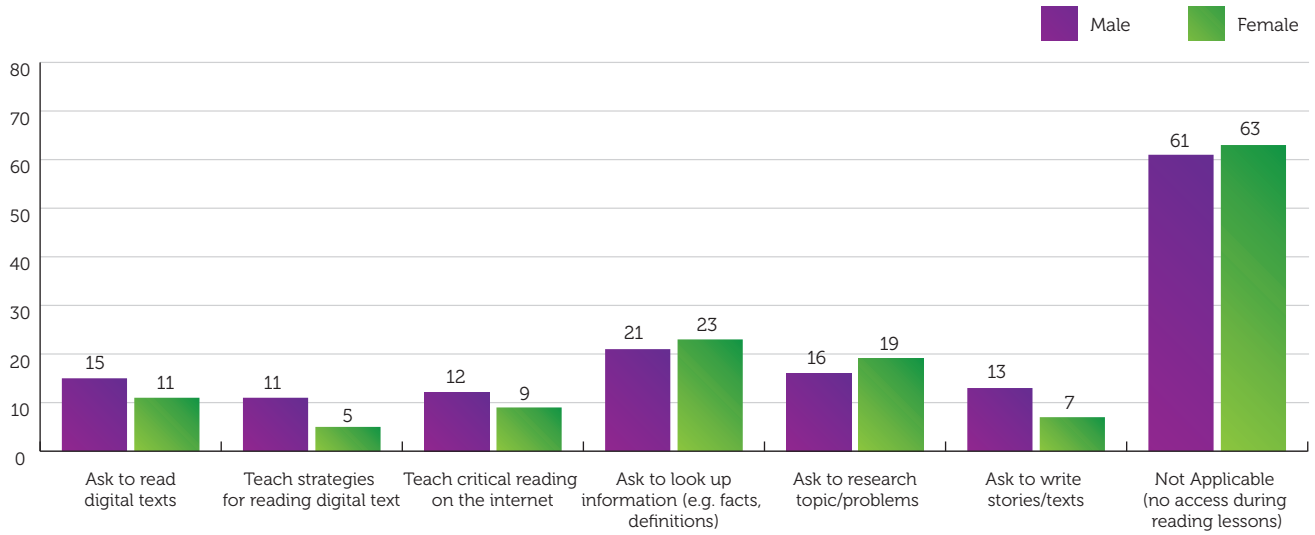
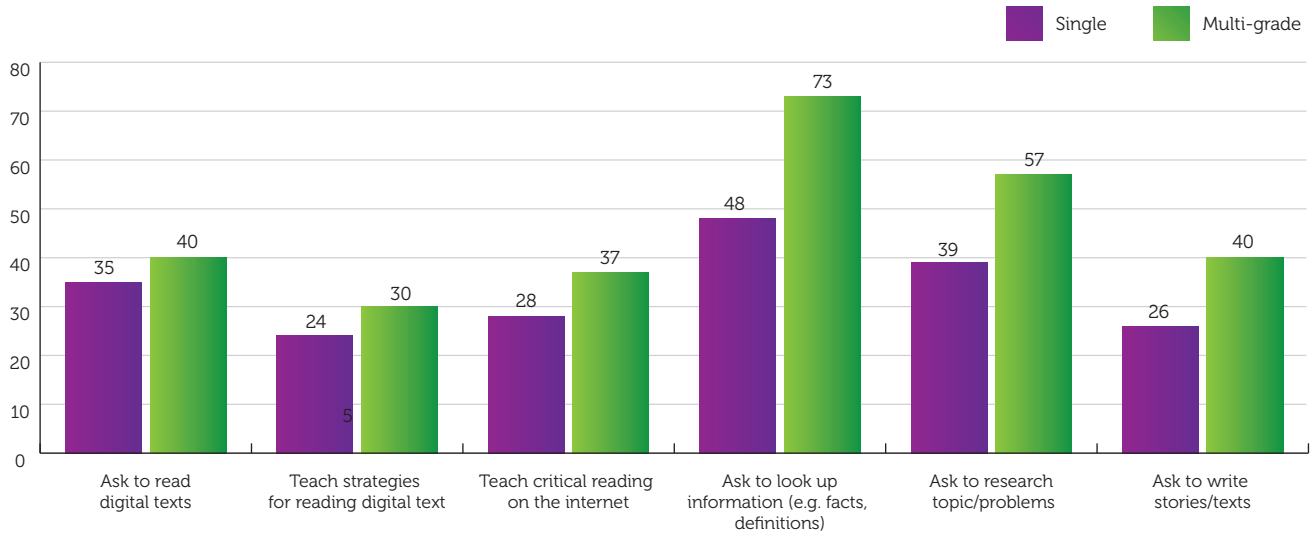


Figure 8 shows similar data, but split by single and multi-grade settings. Pupils in multi-grade classes generally had better access to computers than did pupils in single grade classes. For 65% of pupils in single grade classes, the questions were deemed "Not applicable", compared to 54% in multi-grade classes. This means that usage figures by setting are not really comparable unless the percentages shown are *only* for those who had access to computers. Thus, in reading the Figure, it is important to remember that percentages shown should not be compared against the percentages in Figures 6 and 7 as they exclude the "Not applicable" answers.

The data suggest that teachers in multi-grade settings get pupils to make more frequent use of ICT, generally, but specifically in relation to self-directed activities. For example, 73% of pupils in multi-grade classes who had access to computers were asked to look up information *at least weekly*, compared to 48% in single grade classes. Well over half (57%) were asked to research a topic at least weekly (compared to 39% in single grade classes), and 40% were asked to write a story *at least weekly* (compared to 26% in single grade classes). In contrast, there were smaller differences in the frequency with which pupils were asked to read digital texts or with which teachers taught strategies for reading digital texts.

Figure 8: Percentages of Irish pupils whose teachers use ICT to develop various skills in reading lessons on an at least weekly basis, by single and multi-grade class, excluding those with no access, PIRLS 2016



ACTIVITIES SPECIFIC TO MATHEMATICS INSTRUCTION

Both the National Assessments and TIMSS asked teachers to provide information about how often pupils engaged in various computer-related activities in mathematics lessons. In NA 2009, teachers reported that approximately one-fifth of pupils regularly used computers to practice mathematical facts and basic skills, and slightly fewer (16%) did so to learn mathematical concepts (Table 17). Far fewer pupils were taught by teachers who engaged them in non-routine problem-solving activities or higher-level thinking or handling data (5% and 6%, respectively). More generally, many pupils (48% – 72%) *rarely or never* used computers in mathematics lessons to develop various mathematical skills.

Table 17: Percentages of Sixth class pupils whose teachers use ICT to develop various skills in maths lesson, NA 2009

	At least weekly	Monthly	Rarely or never
Practice mathematical facts and basic skills	21.7	29.0	49.3
Learn mathematical concepts	16.2	36.2	47.6
Engage in non-routine problem-solving or higher-level thinking	5.0	23.5	71.6
Handle data	5.9	36.3	57.8

TIMSS 2011 and 2015 also included three questions on computer use in mathematics classes. In that time period, there was a slight drop in the percentage of Irish pupils who used computers *at least weekly* to explore mathematical principles and concepts, and to practice skills and procedures, whereas the TIMSS averages remained static (Table 18). The percentages of Irish pupils who looked up ideas and information on a weekly basis remained fairly static (from 8% in 2011 to 9% in 2016), but were slightly below the comparable TIMSS averages (11% and 13%, respectively).

As with activities specific to reading instruction, some differences in mathematics instruction emerged, based on teacher characteristics. However, as teacher access to devices in mathematics lessons varied by experience, Figure 9 *only* shows data for those who had access to computers. Again, new teachers were more likely to regularly use ICT to explore mathematical principles and concepts, and far more likely to use ICT to help pupils practice skills and procedures. However, no new teachers reported using computers *at least weekly* to get pupils to look up information as part of mathematics lessons.

Figure 9: Percentages of Irish pupils whose teachers reported engaging pupils in various ICT activities on an *at least a weekly* basis during mathematics lessons, by teachers' years of experience, excluding those with no access to ICT, TIMSS 2015

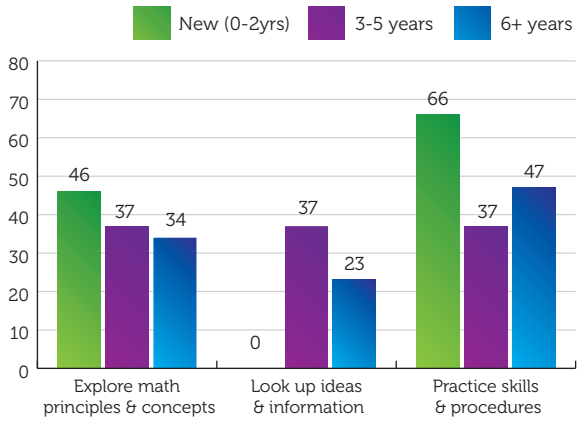


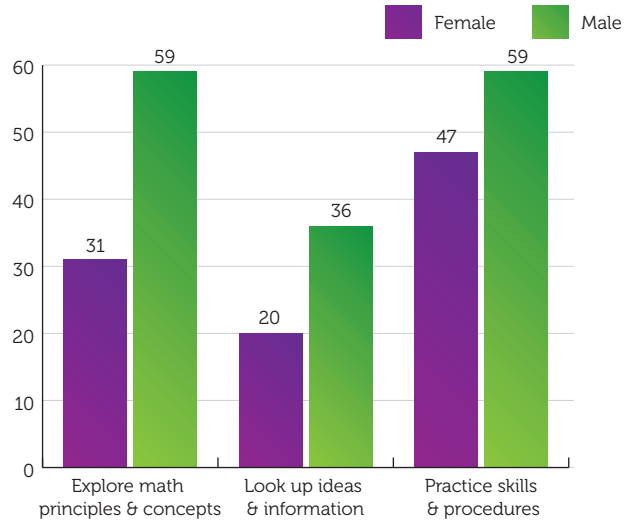
Table 18: Percentages of pupils whose teachers indicated how often they asked pupils to carry out various computer activities in mathematics lessons, TIMSS 2011 and 2015

			At least weekly	Monthly	Rarely or Never	Not applicable*
To explore mathematical principles and concepts	IRL	2011	17.9	24.2	12.5	45.4
		2015	14.5	17.0	8.1	60.4
	TIMSS	2011	11.6	14.9	14.6	58.9
		2015	12.8	13.8	10.6	62.7
To look up ideas and information	IRL	2011	7.9	25.6	21.1	45.4
		2015	9.2	18.3	12.5	60.0
	TIMSS	2011	10.6	15.8	14.8	58.9
		2015	12.7	14.6	10.1	62.7
To practice skills and procedures	IRL	2011	25.0	18.1	11.9	44.9
		2015	19.8	14.4	5.7	60.0
	TIMSS	2011	18.1	16.2	6.9	58.9
		2015	18.8	14.5	4.2	62.6

** Not applicable in this instance means that computers were not available for pupils to use in their reading lessons.*

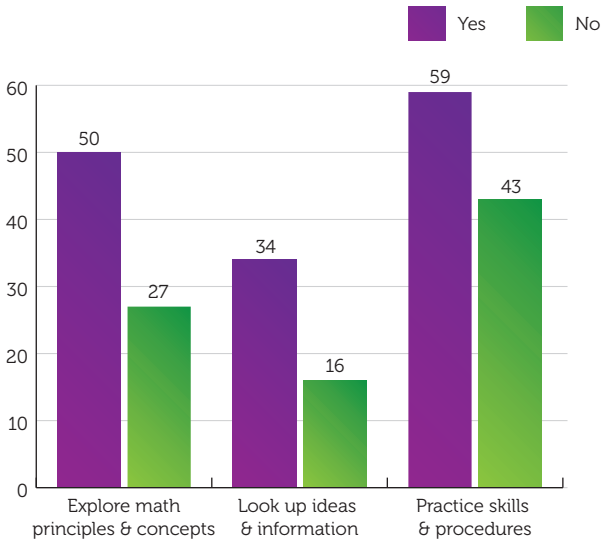
There were also teacher gender differences in reported access to ICT for mathematics lessons. Half of pupils taught by male teachers did not have access to computers for mathematics lessons, compared to 62% of those taught by females. Therefore, Figure 10 again excludes those without access, and shows the percentages for the subset of pupils for whom access was available. Irish pupils taught by males were more likely to regularly use computers in mathematics lessons for a variety of purposes than were pupils taught by females. The difference was most pronounced for exploring mathematical principles and concepts (59% of those taught by a male did so *at least weekly* compared to 31% of pupils taught by a female). However, there were also sizeable differences in the frequency with which pupils taught by a male teacher looked up information in mathematics lessons, and in how often they practiced skills and procedures.

Figure 10: Percentages of Irish pupils whose teachers reported engaging pupils in various ICT activities on at least weekly *basis during mathematics lessons, by teacher gender, excluding those with no access to ICT, TIMSS 2015*



Teachers surveyed as part of TIMSS 2015 were asked if they had taken part in any CPD related to integrating information technology into mathematics during the previous two years. Just over one-third of teachers in Ireland (34%) and internationally (35%) had done so. Some differences emerged in how those who had attended CPD got their pupils to engage in ICT activities (Figure 11 – again, percentages are only those with access to devices in mathematics lessons). Half of pupils whose teacher recently attended CPD were asked *at least weekly* to explore mathematical principles and concepts, compared to 27% of pupils whose teacher had not recently attended CPD. Those who attended CPD were also more likely to regularly ask pupils to look up information and ideas and to practice skills and procedures.

Figure 11: Percentages of Irish pupils whose teachers reported engaging them in various ICT activity on an at least weekly *basis during mathematics lessons, by teacher participation in relevant CPD and excluding those with no access to ICT, TIMSS 2015*



TEACHER CONFIDENCE AND SUPPORT USING ICT

The 2009 and 2014 National Assessments asked teachers about their confidence in using a variety of teaching strategies, including ICT, while PT 2011 asked about degree of comfort with using ICT. As such, the three studies provide data that are broadly, but not exactly, comparable. In NA 2009, only 18% of pupils in Second class (25% of pupils at Sixth class) were taught by teachers who described themselves as *very confident* using computers to teach English (Table 19). Similarly, 20% of pupils in Second, and 19% of pupils in Sixth class, were taught by a teacher who felt *very confident* using computers to teach mathematics.

In 2014, Second class teachers were asked only about teaching English and Sixth only about mathematics. Then, 27% of pupils in Second class were taught by a teacher who was *very confident* using ICTs to teach English and 42% of pupils in Sixth class were taught by a teacher who was *very confident* using ICTs to teach mathematics. Thus, there was a modest increase in teacher confidence in using ICTs between 2009 and 2014, although it should be noted that it remained the teaching strategy of all those listed in which teachers expressed the least confidence.

Table 19: Percentage of pupils, by teachers' confidence using computers/ICTs in classroom instruction, NA 2009 and 2014

			Very confident	Somewhat confident	Not confident
2009	English	2nd class	18.4	53.3	28.3
		6th class	24.9	50.9	24.2
	Maths	2nd class	20.0	42.0	37.9
		6th class	18.8	45.1	36.1
2014	English	2nd class	27.1	55.7	17.2
	Maths	6th class	41.5	45.6	12.8

As part of PT 2011 (falling between the two National Assessments years), teachers were asked how comfortable they were in using computers as part of their classroom instruction. Unlike the National Assessments question, which referred specifically to English and mathematics instruction, the question was general, and elicited a quite positive response from Irish teachers. A majority of Fourth class pupils (67%) were taught by a teacher who *agreed a lot* that they were comfortable using computers in their teaching, with only 2% of pupils taught by a teacher who *disagreed a lot*. Irish teachers were more confident than the PIRLS average (internationally, only 45% were taught by teachers who were very comfortable using computers to teach). However, they still lagged behind teachers in Singapore, Hong Kong and England, where well over 80% of pupils were taught by teachers very comfortable using computers, and teachers in Northern Ireland (79% of pupils' teachers *agreed a lot* they were comfortable using computers in teaching).

It is likely that confidence and comfort with ICTs is linked to the availability of support when difficulties arise. As shown in Table 20, 62% of Irish pupils were taught by a teacher who agreed (either *a lot* or *a little*) that they had access to technical support. While this percentage was higher than the international average of 55%, it was well below the equivalent percentages in Singapore and Hong Kong (over 90%), and in Northern Ireland (82%). The teachers of 71% of Fourth class pupils agreed that they received adequate support for integrating computers into teaching, slightly higher than the international average (56%) but again, well short of the equivalent percentages in Singapore, Hong Kong and Northern Ireland (all over 90%).

Both TIMSS 2015 and PIRLS 2016 asked questions about lack of support for technology. In TIMSS, teachers were asked to what extent was lack of adequate support for using technology a problem in their school, whereas the PIRLS question asked how lack of support for using information technology limited how they taught the PIRLS class (which might be construed as being specific to teaching reading). In both studies, only a minority of Irish pupils' teachers felt lack of adequate support for technology was a *serious* problem (12% in 2015 and 6% in 2016) (Table 21). However, a sizeable percentage felt it was somewhat of an issue. Teachers in Singapore, the Russian Federation, Czech Republic, Hong Kong and Northern Ireland felt best supported, as teachers of no more than 2% of pupils in these countries rated lack of adequate support for technology as a serious problem.

Table 21: Percentages of pupils whose teachers felt that lack of support for technology was a problem in their school (TIMSS 2015) or class (PIRLS 2016)

	Not	Minor	Moderate	Serious
Ireland	39.3	31.5	17.4	11.8
TIMSS 2015	42.9	31.0	17.7	8.5
	Not at all	**Some**	**A lot**	
Ireland	56.2	37.3	6.5	
PIRLS 2016	51.0	40.1	8.9	

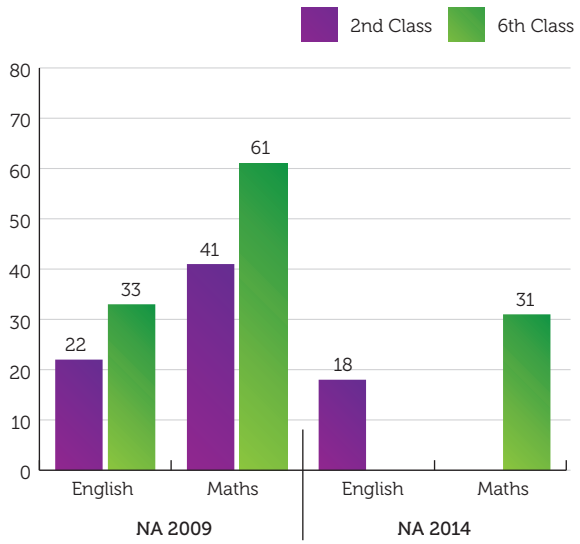
Table 20: Percentages of pupils whose teachers agreed with statements about using computers in classroom instruction, PT 2011

		Agree a lot	Agree a little	Disagree a little	Disagree a lot	Do not use
Access to computer support staff when there are technical problems	Ireland	32.7	29.6	17.4	18.0	2.3
	PT 2011	32.8	22.6	10.7	7.3	26.7
Receive adequate support for integrating computers into teaching	Ireland	34.1	36.6	15.9	11.2	2.3
	PT 2011	31.2	25.3	11.6	5.2	26.7

ICT-RELATED PROFESSIONAL DEVELOPMENT

As part of the National Assessments, teachers were asked to indicate their three personal priorities for CPD. In NA 2009, teachers' prioritisation of ICT as an area of professional development was relatively high overall, but particularly so for mathematics (41% for Second and 61% for Sixth) (Figure 12). Fewer pupils in 2014 were taught by teachers who identified ICT as a priority CPD area (18% for English and 31% for mathematics), but again, ICT was more likely to be perceived as a priority area for mathematics than for English. The drop in the perceived need for CPD related to ICT may represent increased availability and access for relevant CPD courses, or reflect the fact that teachers have become more comfortable using ICT, in general. Nonetheless, a sizeable number of teachers continue to express a need for greater support in integrating ICT into their teaching, particularly in relation to mathematics.

Figure 12: Percentages of pupils taught by teachers who indicated ICT among their three priority topics for CPD in English and mathematics, NA 2009 and 2014



TIMSS 2011 and 2015 asked teachers about their participation in various areas of CPD (in the preceding two years). For each cycle of TIMSS, the proportion of Irish pupils whose teacher attended CPD related to integrating technology into mathematics was broadly consistent with the study averages (Table 22). However, Irish teachers' attendance at CPD related to integrating technology into science was well below the TIMSS average in 2011 and 2015. In Ireland, and across TIMSS as a whole, uptake was higher for mathematics than for science.[6]

Table 22: Percentages of pupils taught by teachers who participated in professional development related to integrating information technology into mathematics and science, TIMSS 2015

		Maths	Science
Ireland	2011	31.3	16.8
	2015	34.4	12.2
TIMSS	2011	33.0	27.9
	2015	35.4	29.5

PUPILS' ENGAGEMENT WITH ICTs AT SCHOOL

This section examines how often pupils in Ireland use computers in school, the nature of their engagement with computers for learning, and their self-efficacy in using computers. It is based on pupil reports of their own behaviour, as distinct from teacher reports of how often they or pupils use computers in class.

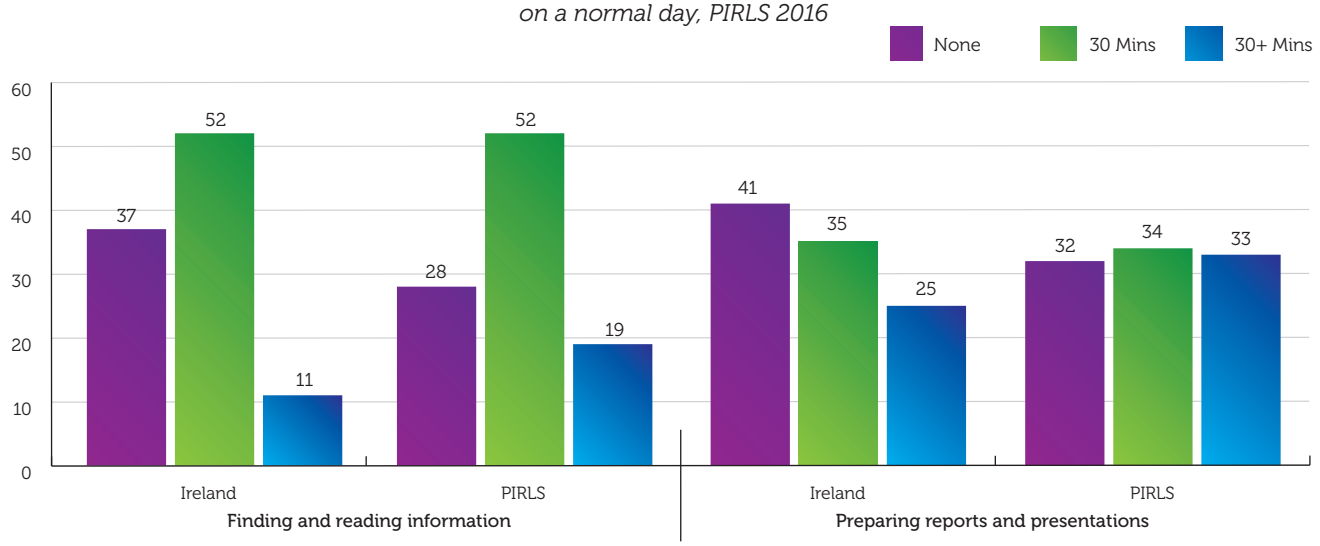
Table 23 shows the extent of computer use in class, based on pupil responses from NA 2009 and 2014. Second class pupils were asked if computers were *often* used as part of their mathematics lessons, whereas Sixth class were asked about the frequency with which computers were used.

Table 23: Percentages of pupils indicating various frequencies with which computers were used in mathematics lessons, NA 2009 and 2014

		Yes - often			No - not often
NA 2009	2nd class	17.9%			82.1
		Always	Often	Sometimes	Never
NA 2009	6th class	0.4	2.4	12.5	84.7
NA 2014	6th class	0.9	5.4	21.8	71.9

6 PIRLS 2011 and 2016 included questions about uptake of CPD related to reading instruction, but did not specifically reference the integration of ICT. In both, uptake was lower in Ireland than the PIRLS average.

Figure 13: Percentage of pupils, by reported time spent on each of the following computer activiites for schoolwork on a normal day, PIRLS 2016



As reported by pupils, computers are used relatively rarely in mathematics. At Sixth class, there has been an increase in computer use in mathematics between 2009 and 2014 (from 85% to 72% *never* using them), but a large majority still did not use computers in mathematics lessons.

In PT 2011, pupils were asked how often they used computers at school, whereas in TIMSS 2015 and PIRLS 2016 they were asked how often they used computers or tablets for schoolwork (including homework) at school. As shown in Table 24, there has been a sizeable drop in the percentages of Irish pupils regularly using computers in school (from 46% in 2011 to 23% in 2016). It might be possible to attribute some of the drop to the change in how the question was asked, especially as there was also a drop in the international study averages in 2015 and 2016. However, the drop is not as pronounced as in Ireland. Internationally, there was a 13% increase from 2011 to 2016 in the percentage of pupils *never or almost never* using computers in school (from 35% to 48%), but the increase in Ireland was almost twofold (from 30% to 58%).

Table 24: Percentages of pupils indicating varying frequencies with which computers were used in school, PT 2011, TIMSS 2015 and PIRLS 2016

	Regularly	Occasionally	Never or almost never
Ireland PT 2011	46.2 48.5	23.6 16.6	30.2 34.8
Ireland T 2015	26.4 36.8	15.0 13.6	58.7| 49.7
Ireland P 2016	23.3 37.6	18.6 14.4	58.0 48.1

Pupils in PIRLS 2016 were also asked how much time they spent on a normal school day using a computer or tablet for their schoolwork – both for finding and reading information, and preparing reports and presentations. Higher percentages of Irish pupils reported spending *no time* finding and reading information (37%) or preparing reports and presentations (41%) than the comparable international averages (28% and 32%, respectively) (Figure 13).

Only a minority of countries that took part in PIRLS also took part in ePIRLS. However, for those that did, some additional information is available about how pupils in these countries learned certain computer skills. Generally, half or more of pupils described themselves as mainly self-taught in computer use, typing, and finding information on the internet (Table 25).The next most common source of instruction was family (approximately one-third of pupils in Ireland and internationally indicated that family was the main source for learning about using a computer and finding information on the internet, while almost one-quarter learned typing from family members).

Interestingly, the responses from Irish pupils suggest that they were less likely than the ePIRLS average to be taught computing skills by a teacher. For example, only 6% indicated that a teacher was their main source of instruction for learning how to use a computer (ePIRLS average: 14%), while only 14% indicated that a teacher was their main source of instruction for finding information on the internet (ePIRLS: 21%). Given the importance of critical skills in evaluating internet content, this suggests an area to which more attention might be paid in classrooms.

Table 25: Percentage of pupils reporting how they learned various computer skills, ePIRLS 2016

		Self-taught	Teacher	Family	Friend	Never learned
To use a computer	Ireland	50.9	6.2	40.0	1.7	1.2
	ePIRLS 2016	45.6	13.9	37.1	2.4	1.0
Typing	Ireland	64.6	11.9	21.2	1.0	1.2
	ePIRLS 2016	53.6	18.2	23.8	1.6	2.9
Finding information on the internet	Ireland	49.6	14.2	32.6	2.7	0.9
	ePIRLS 2016	44.2	20.9	30.8	2.5	1.6

PUPILS' SELF-EFFICACY IN COMPUTER USE

As part of ePIRLS, a self-efficacy measure was created based on pupils' level of agreement with three statements on their perceived ICT competence (e.g., 'I am good at using a computer'). As was true of other participating countries, the vast majority of Irish pupils who undertook the ePIRLS assessment perceived themselves to have good or very good computer skills and abilities. In Ireland, 55% of pupils fell into the high self-efficacy category (ePIRLS: 51%), and just 6% fell into the low category (ePIRLS: 8%).

6.ICT usage at home

This section examines pupil use of ICT at home. A certain degree of caution is needed when comparing answers from the various studies. This is because the questions asked were worded differently, or asked about similar (but not identical) activity. Also, the nature of questions asked means that they did not generally lend themselves to producing an *overall* measure of the amount of time spent using ICT at home. For example, we cannot add the categorical amounts of time spent on games, videos, and chatting to produce an overall amount of time spent in front of a device.

However, PT 2011 included a general question about computer use, showing that only 5% of Irish pupils, compared to 13%, internationally, said they *never* used a computer at home (Figure 14). Almost half of pupils, internationally, were *daily* computer users at home, as were 42% of Irish pupils.

Regarding specific uses, the three most recent National Assessments and PIRLS 2016 all asked about playing computer games, while PIRLS and NA 2009 and 2014 also asked about internet use, but phrasing differed. Second class pupils in the National Assessments were simply asked if they played computer games or used the internet on a school day (Yes/No response option), whereas older pupils were asked how much time they

Figure 14. Percentages of pupils reporting various frequency of computer use at home, PT 2011

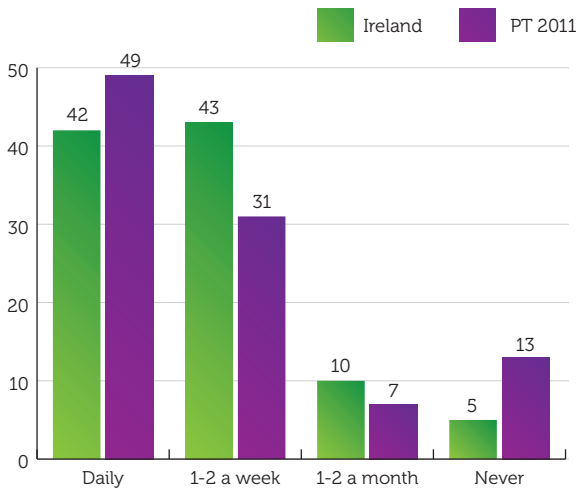


Table 26. Percentages of pupils who reported spending at least some time using computers or digital devices for leisure activities, NA 2004, 2009, 2014, PIRLS 2016

				%
Games	electronic/computer games on a school day	NA 2004	5th class	67.9
	games on computer/console on a school day	NA 2009	2nd class 6th class	64.8 79.5
	games on computer/console on a school day	NA 2014	2nd class 6th class	73.4 71.0
	Playing games	P 2016	Ireland PIRLS	89.6 86.4
Internet	Use on a school day	NA 2009	2nd class 6th class	51.7 77.4
	Use a school day	NA 2014	2nd class 6th class	70.5 92.7
	Browsing online	P 2016	Ireland PIRLS	62.1 68.0

Table 27: Percentage of pupils spending various amounts of time on computer activities, PIRLS 2016

		None	< 30 mins	30-60 mins	1-2 hours	2 hours +
Playing games	Ireland	10.4	35.8	26.5	11.6	15.7
	PIRLS	13.6	29.5	26.0	13.5	17.5
Watching videos	Ireland	15.1	31.5	25.2	13.1	15.2
	PIRLS	17.6	31.1	23.6	14.4	13.3
Chatting	Ireland	34.2	30.6	16.7	8.0	10.5
	PIRLS	40.0	31.6	13.6	6.7	8.0
Browsing online	Ireland	37.8	35.7	13.3	5.3	7.8
	PIRLS	32.1	33.5	16.2	8.1	10.2

spent. In contrast, PIRLS asked pupils about frequency of surfing the internet and playing games on a computer, but not restricted to school days. With these caveats in mind, the data show a very slight increase in the percentages playing computer games on school days (from 68% in NA 2004 to 73% in NA 2014) and a higher percentage again (90%) when the question was not restricted to school days (Table 26).

There was a sizeable increase between NA 2009 and 2014 in the percentages of Second and Sixth class pupils who used the internet on school days (from 52% to 70% at Second class and from 77% to 93% at Sixth). However, a smaller percentage (62%) of Irish pupils in PIRLS 2016 indicated that they spent at least some time browsing online, slightly lower than the international average of 68%. The drop in reported use from 2014 to 2016 may be slightly misleading though, as "browsing online" was one of four computer activities asked about. Also, the phrase might be considered more restrictive than the rather general "using the internet".

PIRLS 2016 included more detailed questions about the amount of time spent on various activities on a computer or online (Table 27). Almost two-thirds (62%) of Irish pupils spent up to an hour a day playing games on a computer, while 10% did not play computer games. Time spent playing games was broadly in line with the international average, with 27% of Irish pupils (31%, internationally) playing games for at least an hour a day. Game-playing varied by gender. For example, while 13% of Irish girls spent no time playing computer games, the equivalent figure for boys was 8%. Likewise, while 22% of Irish boys spent in excess of two hours per day on computer games, only 9% of girls did so.

Watching videos was also common, with 28% of pupils in Ireland and internationally spending at least an hour a day watching videos on a computer. Generally, girls spent less time than boys watching videos, but the differences were not as pronounced as for playing computer games. For example, 12% of girls and 18% of boys in Ireland spent at least two hours a day watching computer videos. Chatting online was far less common than gaming or videos, with 34% of Irish pupils never doing so (international average: 40%). In contrast to gaming and videos, boys in Ireland were less likely than girls to spend time chatting online (38% of boys versus 30% of girls never chatted online). Browsing online was also less popular than gaming and videos. Thirty-eight percent of Irish pupils did not browse online, compared to the PIRLS average of 32%. In terms of heavy usage, only 13% of Irish pupils spent more than an hour a day browsing online, compared to a PIRLS average of 18%.

USING COMPUTERS FOR SCHOOLWORK

As well as using computers for fun, computers can be used at home for homework and school projects. Both TIMSS 2015 and PIRLS 2016 included general questions about using computers for schoolwork, whereas the NA 2009 and 2014 included subject-specific questions. In 2009, pupils were asked about using computers for maths homework. Then, a large majority (83% of Sixth class and 89% of Second class pupils) reported *almost never* using them, while only 4% of Sixth class pupils used them at least once or twice a week (Table 28). In NA 2014, Sixth class were again asked about using computers for maths homework while Second class were asked about English homework. The percentages *almost never* using computers for homework were noticeably lower than in 2009 (63% of Second and 68% of Sixth class), but still comprised a sizeable majority of pupils.

In contrast, the more general question of using computers at home for schoolwork elicited higher reports of usage. In TIMSS 2015, Irish pupils' use was broadly in line

Table 28: Percentage of pupils reporting various frequencies of use of computers at home for schoolwork, NA 2009, 2014, TIMSS 2015 and PIRLS 2016

			Daily/ Always*	1/2 a week/ Often	1/2 a month / Sometimes	Never / Almost never
Computer for maths homework	NA 2009	2nd class 6th class	- 1.6	- 2.7	- 12.6	88.6 83.2
Computer for English homework	NA 2014	2nd class	-	-	-	63.3
Computing device for maths homework	NA 2014	6th class	1.7	4.8	25.6	67.9
Computer for schoolwork	T 2015	Ireland TIMSS	37.5 37.3	24.1 26.7	14.5 14.1	23.9 21.9
Computer for schoolwork	P 2016	Ireland PIRLS	13.9 33.1	16.7 27.4	23.6 16.7	45.8 22.8

** Frequency categories shown are for PIRLS and TIMSS (Daily, Once or twice a week, etc.) followed by NA (Always, Often, etc.).*

with the TIMSS average, with 62% using them at least *once or twice a week* (international average: 64%). Further, the percentage *never* using computers for schoolwork at home was only 24%, considerably lower than similar data from NA (although based on *almost never* responses). However, in PIRLS 2016, there was a marked decrease from TIMSS 2015 in the percentages of Irish pupils using computers at home for schoolwork, despite the fact that the international average percentages for the two studies were very similar. In 2016, 46% of Irish pupils said they never used computers at home for schoolwork, double the PIRLS average of 23%. Also, only 31% – or half the PIRLS average – used them at least once or twice a week.

The reason for the sudden decrease in use in Ireland is unclear, especially given that Irish pupils had almost universal access to computers at home in 2016. To put the unusual nature of the data in context, the only PIRLS 2016 country with less frequent use of a computer at home for schoolwork was Morocco, and the only other country that came close to Ireland's low levels of use was Iran.

7. Summary

This report has drawn on multiple data sources over the period 2004-2016 to explore the availability and use of digital devices in homes and primary schools in Ireland, over time and relative to any available international comparisons. It is apparent that there have been large increases in home access and use. Irish homes now have almost universal access and are at least as digitally connected as is the international norm. Irish pupils regularly use computers at home, play games and use the internet with at least the same level of frequency as found internationally. For example, only 5% of Irish pupils surveyed as part of PIRLS and TIMSS in 2011 said they *never* used a computer at home (international average: 13%), while PIRLS 2016 showed that 90% of Irish pupils spend at least some time each day playing computer games.

The research shows that computers and ICT are integral parts of home life for the average Irish primary school pupil. The same cannot be said for Irish primary schools. If anything, the same research suggests that pupils' engagement with computers as part of their learning environment dropped over the time period examined. Of course, the national averages mask a variety of levels of engagement. For example, PIRLS and TIMSS data showed recently-qualified teachers were more likely than experienced teachers to use computers regularly in mathematics and reading lessons. That said, even amongst recently-qualified teachers, regular use during lessons was not that common, as a majority did not have access to computers during lessons.

> *"Computers and ICT are integral parts of home life for the average Irish primary school pupil. The same cannot be said for Irish primary schools."*

Engagement requires resources, and while there has been a steady stream of policy documents related to ICT since Schools IT2000, funding streams and infrastructural projects have been more sporadic and have rarely matched the levels recommended in the various policy documents. The sizeable funds provided under the ICT Equipment grant began to be distributed from January 2017. The more detailed analyses in this report extend only to 2016, but they revealed significant issues with the number of devices available, with the capacity of staff to use or to support the ICT infrastructure in their schools, with connectivity, quality of resources, and use by pupils. These are summarised next, with comment on the current situation, where information is available.

ACCESS TO DEVICES

The pupil:computer ratio is a key indicator in monitoring availability of digital resources in schools. Data from the National Assessments in 2004, 2009 and 2014 show no clear improvement in the ratio over that time period. More recent data from PIRLS 2016 also suggest quite poor pupil access to devices, relative to international averages. Fewer than 3% of Irish pupils had their own device in school, compared to a PIRLS 2016 average of just over 10%. Some countries participating in PIRLS achieved good levels of device access by supplementing school devices with a Bring Your Own Device (BYOD) policy. However, such a policy requires very good broadband connectivity and wi-fi coverage throughout the school, as well as the technical support skills required to manage device access, prevent unauthorised or inappropriate access, and apply safeguarding tools (e.g., European Schoolnet's guide to BYOD for school leaders and administrators

http://www.eun.org/documents/411753/817341/BYOD_Technical_guide_full_v7.pdf/). As such, BYOD may not be a feasible option for many Irish primary schools.

While the studies reported here pre-date the ICT equipment grants, anecdotal evidence from the more recent piloting and standardisation of the new Drumcondra tests at primary level (in 2017 and 2018) suggests that many schools still have serious deficiencies in their ICT capacities. About half of the nationally representative sample of schools that took part in the standardisation in 2018 asked to be provided with additional laptops or bandwidth (or both) in order to assess pupils using the cloud-based system. In a related vein, over half of those who completed IPPN's 2018 pre-conference survey (albeit not a representative sample) felt that the introduction of coding in the mathematics curriculum would be problematic in their school due to inadequate ICT resources.

> *"The research reveals a number of areas of concern regarding the frequency with which Irish pupils use computers as part of schoolwork, and the nature of that use."*

ACCESS TO TECHNICAL SUPPORT

In the same IPPN survey, 44% of respondents indicated that in spending their school's ICT grant, priority was being given to new computers for teachers and pupils. This suggests that the grant is likely to gradually improve pupil access to devices in many schools. However, the grant does not address schools' ongoing difficulties in providing technical support and maintenance, and no additional funds are provided to schools to support existing or additional resources. This seems a rather large oversight, as lack of adequate technical support and expertise is a significant problem.

For example, PIRLS and TIMSS data showed that a sizeable number of Irish pupils were in schools where principals and/or teachers felt that a lack of access to support staff or lack of support for technology hampered instruction. Concerns about technical support were flagged in a number of policy documents (e.g., the report of the ICT Strategy Group, *Smart Schools = Smart Economy*, and the Inspectorate's 2008 report on ICT). More recently, lack of technical support was flagged by IPPN in their submission to the Joint Oireachtas Committee (2015), while access to technicians and to ICT support were rated by IPPN members as two of the three *least adequate* resources in their school (Riley, 2015). A more recent INTO survey found heavy reliance by schools on external private companies to support and maintain ICT equipment, with principals noting the challenge of keeping up to date with technology, and commenting how "precious teaching and learning time is lost as a consequence of technical issues" (INTO, 2017, p.29).

Neither IPPN nor INTO surveys were based on a representative sample, but they broadly align with reports from principals in the 2013 ICT Census, who indicated that while they used a mixture of methods to provide technical support, most relied at least in part on external private companies (Cosgrove et al., 2014). The surveys also align with my own experiences dealing with ICT infrastructure in representative samples of primary schools for ePIRLS and during the development of the digital version of the Drumcondra Reasoning Test. Although I did not formally collate information about the type of technical supports in place, it was very evident that most schools would have benefited from better supports and advice. Few had a formal support agreement with an IT company that provided adequate levels of support. Where external support was provided, it tended to take the form of scheduled maintenance and support, and was slow to respond to unexpected issues. In many cases, technical support was mainly provided by interested teachers and/or parents. The lack of a coordinated model of support contributed to issues with school resources, such as devices and software not being updated, or older content not removed or archived. A small number of schools had poor connectivity, not due to coverage problems in the local area, but because someone had put their router in a poor location in the school.

CONNECTIVITY

Of course, most connectivity problems are not attributable to poor positioning of routers. The 2014 National Assessments showed that over two-thirds of pupils were in schools where principals felt that slow internet speed hindered teaching and learning. While all post-primary schools have benefited from the rollout of 100 Mbps broadband, many primary schools still do not have reliable, basic bandwidth. Neither PIRLS nor TIMSS asked specifically about schools' internet speed, but communication with schools during ePIRLS suggested that many lacked a reliable connection. For example, connectivity was not needed to take the ePIRLS test as it operated in a simulated internet environment, but it was needed to upload test results to a secure server. It quickly became apparent that widespread connectivity issues meant uploading results from within schools was not a reliable option.

More recent reports (admittedly, from non-representative samples) suggest that issues remain. For example, IPPN surveys show that as late as 2018, 12% of respondents reported a dial-up connection in their school, and 34% reported that they did not have a reliable internet connection. The European Commission's (2019) most recent survey of ICT in schools shows that across the EU, while fibre optic connections have increased and ADSL connections have decreased since the earlier 2011/12 survey, fibre optic remains less common at primary than post-primary level, and less common in Irish primary schools than is the average across the EU.

USE BY PUPILS

The research reported reveals a number of areas of concern regarding the frequency with which Irish pupils use computers as part of schoolwork, and the nature of that use. PIRLS and TIMSS data show that Irish pupils engaged relatively frequently in information retrieval activities but engaged less frequently in higher-order activities (i.e., activities that require pupils to go beyond rote learning and memorisation, and draw on their capacity to analyse, synthesise and evaluate). Also, teaching pupils to be critical when reading on the internet – a very important skills in the era of "fake news" – was a less common activity in Irish classrooms than across most PIRLS participating countries.

Comparing PIRLS 2011 to 2016, the percentage of Irish pupils regularly using computers in lessons halved (from 46% to only 23% in 2016). In 2011, Irish pupils at least matched the international average for computer use in school, but by 2016 were well below the international study average. Of course, use is linked to the availability and quality of resources, so it is a concern that in 2016, close to half of Irish pupils were in schools where the principal felt that instruction was affected by inadequate software for reading and mathematics instruction.

> *"The only country where a larger percentage of children reported rarely or never using a computer at home for schoolwork was Morocco, and the only other country that came close to Ireland's low levels of use was Iran."*

Finally, one of the more surprising findings from the current review was the large drop in home use of computers for schoolwork. Irish homes are well equipped with digital devices, but these do not seem to be regularly drawn upon to complete schoolwork. To put the unusual nature of the Irish data in context, across PIRLS 2016 as a whole, the only country where a larger percentage of children reported rarely or never using a computer at home for schoolwork was Morocco, and the only other country that came close to Ireland's low levels of use was Iran.

8. Looking to the Future

The writing of this final section coincided with yet another media debate about whether computers and tablets in schools were a force for harm or for good. To me, this type of debate seems about as sensible as debating the value of books. It fails to recognise that the relationship between ICT and achievement is complex. Like books, computers are a tool that can facilitate learning, but their mere availability in a classroom is not sufficient to transform learning. What matters is the quality of the tool, and how teachers use that tool as part of instructional activities. More importantly though, this type of debate fails to recognise that ICT is an integral part of our lives. Children need an understanding of, and familiarity with, ICT. If technology does not feature in school life, school does not reflect life.

"The relationship between ICT and achievement is complex. Like books, computers are a tool that can facilitate learning, but their mere availability in a classroom is not sufficient to transform learning."

From that personal general standpoint, I offer some final thoughts on issues that are likely to remain even after the benefits of recent additional funding begin to take effect. Some are issues that can be addressed by school leaders, while others require input from other stakeholders, such as the DES.

ISSUES FOR SCHOOL LEADERS

Three issues spring to mind that merit the attention of school leaders – how pupils use ICT, how schoolwork draws on ICT, and issues related to CPD.

While much of this report has focussed on the (easier-to-measure) frequency of use of ICT and access to devices, *how* ICT is used is perhaps of more interest. The studies drawn upon here suggest that there is room for improvement in how Irish teachers use ICT. As noted, PIRLS 2016 revealed that teaching critical evaluation of material on the internet received relatively little attention in Irish schools. Given the proliferation of "fake news", the capacity to evaluate the reliability of information presented on the internet is a particularly important skill that needs closer attention. It is a skill that can be taught as a whole-class activity and does not require extensive ICT resources. PIRLS and TIMSS data also suggest that tasks requiring higher-order activities are not a prominent feature of Irish pupils' ICT use. However, research suggests that the largest benefits from ICT accrue when pupils use computers for the types of complex problems that tap into higher-order thinking skills (e.g., Wenglinsky, 2006). Thus, consideration needs to be given to changing the types of activities in which pupils are asked to engage – less memorisation or information retrieval and more synthesis, evaluation and problem-solving.

PIRLS 2016 data showed that use of ICT for schoolwork at home was infrequent in Ireland, out of kilter with the availability of ICT in Irish homes, and with practice elsewhere. Relative to other countries, homework in Ireland tends to be assigned very frequently but in small, discrete doses (e.g., Clerkin, 2013). It is worth considering how to vary the types of homework assigned and to examine the value that homework might add. Rather than using it to simply practice or reinforce skills learned, it is worth exploring more frequent use of larger, project-based tasks. Such tasks could help develop pupils' research and evaluative skills, ICT-related, and more generally.

Regarding CPD, data from the National Assessments indicated a strong interest among teachers in CPD related to integrating ICT into instruction, particularly in mathematics. However, PIRLS and TIMSS show that uptake of CPD was not particularly high among Irish teachers relative to international averages, and was noticeably poorer for CPD related to integrating ICT into science (Clerkin, Perkins & Chubb, 2017). To support the *Digital Learning Framework,* PDST-TiE now provide an expanded CPD programme to assist schools in embedding digital technologies into learning and teaching. Ideally, school leaders should draw on this expanded programme to support more teachers in accessing CPD that focusses on subject-specific pedagogical approaches for ICT integration. In particular, CPD for mathematics and science would be beneficial.

WIDER ISSUES

In terms of wider issues, the two most obvious are ongoing problems with connectivity and the lack of technical supports. The poor quality of connectivity in many Irish primary schools is an issue that is well-known. As such, it is not dealt with in depth here, other than to reiterate that it remains a *major* obstacle to ICT use in many schools, and that it should be dealt with as a matter of urgency. It is neither equitable nor sensible that all post-primary schools are guaranteed access to highspeed broadband of at least 100 Mbps, while primary schools have no guarantee of any connectivity. Providing quality connectivity to all primary school pupils should be an educational priority in its own right, not something appended as a priority to the eventual implementation of the National Broadband Plan.

> *"Given the proliferation of "fake news", the capacity to evaluate the reliability of information presented on the internet is a particularly important skill that needs closer attention."*

In contrast to connectivity issues, the lack of a coherent model of technical support for Irish primary schools is an issue that rarely receives public attention, yet is an obvious problem. Relative to most other countries, the Irish education system is characterised by a large number of very small schools. For example, Eivers and Chubb (2017) noted that the average Irish primary school was less than half the size of the international average in TIMSS 2015, and that 41% of Irish schools had fewer than 100 pupils. Smaller schools have fewer staff and, consequently, a smaller pool of in-house ICT expertise on which to draw. Further, as schools are often located in quite rural locations, this creates additional difficulties for connectivity and accessibility. Despite this, there is little or no centralised technical support available for Irish schools (excluding general advice, such as purchasing frameworks). Each school must reinvent their own ICT wheel. Some do so with great skill while others do not. This is not a criticism of the staff in those schools. It would be a poor use of skills to ask an IT professional to teach phonics to young children, and it is an equally poor use of skills to ask primary teachers to manage ICT facilities in a school. Some may produce excellent results, but it uses teacher time that would be more effectively spent on teaching and learning.

Northern Ireland featured in a positive light in a number of places in this report (typically alongside Singapore and Hong Kong). Teachers in these three jurisdictions were generally satisfied with ICT infrastructure and supports in their school. Singapore and Hong Kong are quite different to schools in Ireland as they typically have very large enrolment, are located in urban areas (e.g., see Eivers & Chubb, 2017), are digitally well-connected and can therefore facilitate in-house technical support in a way that is rarely feasible here. In contrast, Northern Ireland has a preponderance of small schools, many of which are in rural areas. Thus, the model of technical support used there is of interest here.

The ICT needs of schools in Northern Ireland are centrally supported through an outsourced contract. The contract is awarded and managed by an agency called C2K (originally, Classrooms 2000). The services covered by the contractor, Capita, include Local Area Networking, Wide Area Networking, provision of broadband connectivity and a school administration system, email hosting, help-desk services, and a virtual learning environment. Pupils and teachers have access

to the "Education Cloud", which includes a wide range of digital content to support the curriculum, products such as Microsoft's Office 365 and Google's G-Suite for Education, and centralised backup and archiving services.

In terms of costs, C2K were originally awarded a 5-year, £170 million contract in 2012, a contract that was recently extended. Applying contemporaneous exchange rates, the 2012 contract was worth about €210 million, meaning that (ignoring inflation) it is more or less the same amount as the Digital Strategy ICT infrastructure grant, also spread over a 5-year period. For context, the contractors Capita must supply all technical support for a primary and post-primary school population that (in 2012) consisted of approximately 305,000 students and 1,200 schools (Northern Ireland Statistics and Research Agency, 2013). This is considerably smaller than our own school population of approximately 930,000 students and almost 4,000 schools (according to the DES' key statistics for 2018/19).

Drawing on my own experiences in Northern Ireland's education system, the centralised technical support system does not solve all problems, and it is not cheap. However, it facilitates pupil access to better resources, and it frees teachers to teach. A centrally managed technical support service for Irish schools is hardly a new idea. It has previously been proposed in a number of policy documents, including *Smart Schools = Smart Economy*, and the Inspectorate's 2008 report on ICT. However, those documents are at least 10 years old. In the interim, ICT has become ubiquitous and its potential value as an instructional tool has increased exponentially, but that value has not been adequately harnessed in Irish primary schools. The past 10 years have also seen exponential increases in the risks associated with poorly managed infrastructure and non-secure systems. The responsibility for dealing with such risks should not fall solely on the shoulders of a school management team.

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