

Inspiring Digital Learning

A synthesis of research related to digital technologies in Northern Ireland's schools

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informing



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Inspiring Digital Learning: a synthesis of research related to digital learning in Northern Ireland's schools.

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PREFACE

The use of computers in Northern Ireland classrooms goes back nearly fifty years¹. The decision, in 1990, by the Department of Education² to provide administrative computers to schools through a centrally managed ICT service (at no cost to school budgets) to support the local management of schools and delegation of budget³ established an equity policy for the provision of digital technology services in schools which sustains to this day, thirty-three years later.

When the CLASS project was extended⁴ in 1997, to provide systems to support teaching and learning, it created a world-class service, the envy of other jurisdictions and one of the enduring strengths of education in schools here.

To support evolution in meeting the changing needs of schools, the Innovation Forum⁵, part of the Education Network for Northern Ireland (ENNI) C2k service, focuses attention on the innovative uses of digital technologies in schools by monitoring, evaluating and promoting classroom and leadership practices. The title of this briefing paper *Inspiring Digital Learning* reflects the Forum's actions to *promote* innovative practices, using digital technologies, which *inspire* both learners and learning leaders.

The purpose of the Education Authority's (EA) Education Information Solutions (EdIS) Programme (building on the EA Digital Strategy for Learning) is to extend increasingly effective, high-quality managed information solutions to facilitate school improvement, through to the 2030s and beyond.

The Innovation Forum is pleased to provide this evidence-based brief to the Independent Education Review Panel to contribute to their goal of envisioning an excellent education service, looking forward twenty years, addressing the challenges, while building on the very many strengths in our schools, of which the provision and use of digital technologies is one.

John Anderson Independent Chair of the EN(ni) Innovation Forum February 2023

¹ In 1974 a National Development Programme in Computer Assisted Learning project based at the (then) New University of Ulster developed a mainframe computer assisted management of learning program providing 'assessment for learning' diagnostic tests, in an Advanced Level Chemistry course in Methodist College, Belfast providing individual feedback to students on their learning. The first microcomputers appeared in classrooms from 1977.

² Financed through public-private partnership investment and the European Economic Community

³ The CLASS (Computerised Local Administration of Schools) Project

⁴ Classroom 2000, later named C2k

⁵ See Appendix 1

1 OVERVIEW

This briefing report synthesises evidence from research and evaluation studies into effective use of digital technologies in Northern Ireland classrooms today and corroborates it with reference to relevant international evidence.

To ensure that the evidence from Northern Ireland’s schools is relatively contemporaneous, we have looked back only to 2010, analysing 44 research, review and reference papers (based on evidence from over 370 school research study visits⁶), and including a small number of publications prior to 2010.

With a shared focus on the realisation of ‘excellent education’ set out by the Independent Education Review (IER) Panel, the report provides a strong basis for recommendations about the realistic contributions which the use of digital technologies makes to address issues identified by the Panel.

The findings are organised here using the issues which the Panel set out in section 4 of their 2022 Interim Report⁷. They are summarised as at-a-glance headlines in **Section 2** (the Synopsis) and expanded in **Section 3**. The findings relate to eight of the Panel’s ten issues, but evidence about the effective uses of digital technology bears across several of the Panel’s issues, resulting in inevitable repetition in Section 3: readers may therefore wish to review all parts of the section.

Section 3 summarises the nuances of the research evidence in more detail, followed by reference to related evidence from international sources, from literature reviews where appropriate, as these gather evidence from countries worldwide. Readers are encouraged to follow up individual reference sources (see Appendices 1 and 2) for more detail.

Also, relevant to each issue, there are references to related projects underway, or planned, through the EdIS Programme⁸. The objectives of the EdIS Programme are to:

- improve the learning experience;
- improve educational outcomes;
- develop skills for the future;
- support teaching using technology;
- support professional learning;
- increase parental engagement; and
- simplify school administration.

⁶ 370 school study visits, based on 22 publications which reported the number of schools involved

⁷ <https://www.independentreviewofeducation.org.uk/files/independentreviewofeducation/2022-10/Interim%20Report%20-%20Published%2012.10.22.pdf>

⁸ <https://www.eani.org.uk/services/education-information-solutions-programme-edis>

The research evidence here can be relied upon to understand and appreciate what is being achieved day-in, day-out by excellent teachers and learning leaders in Northern Ireland classrooms. These are not likely to be rare examples: effective pedagogy, excellent learning leadership and successful learning, enhanced by digital technologies, are widespread experiences, but can sometimes go unacknowledged - except by the learners themselves. Summarising local evaluations reveals that a better balance of studies is needed, where there are less – such as, for example, in early years, special education, Irish-medium education and in professional learning and accreditation for teachers and learning assistants.

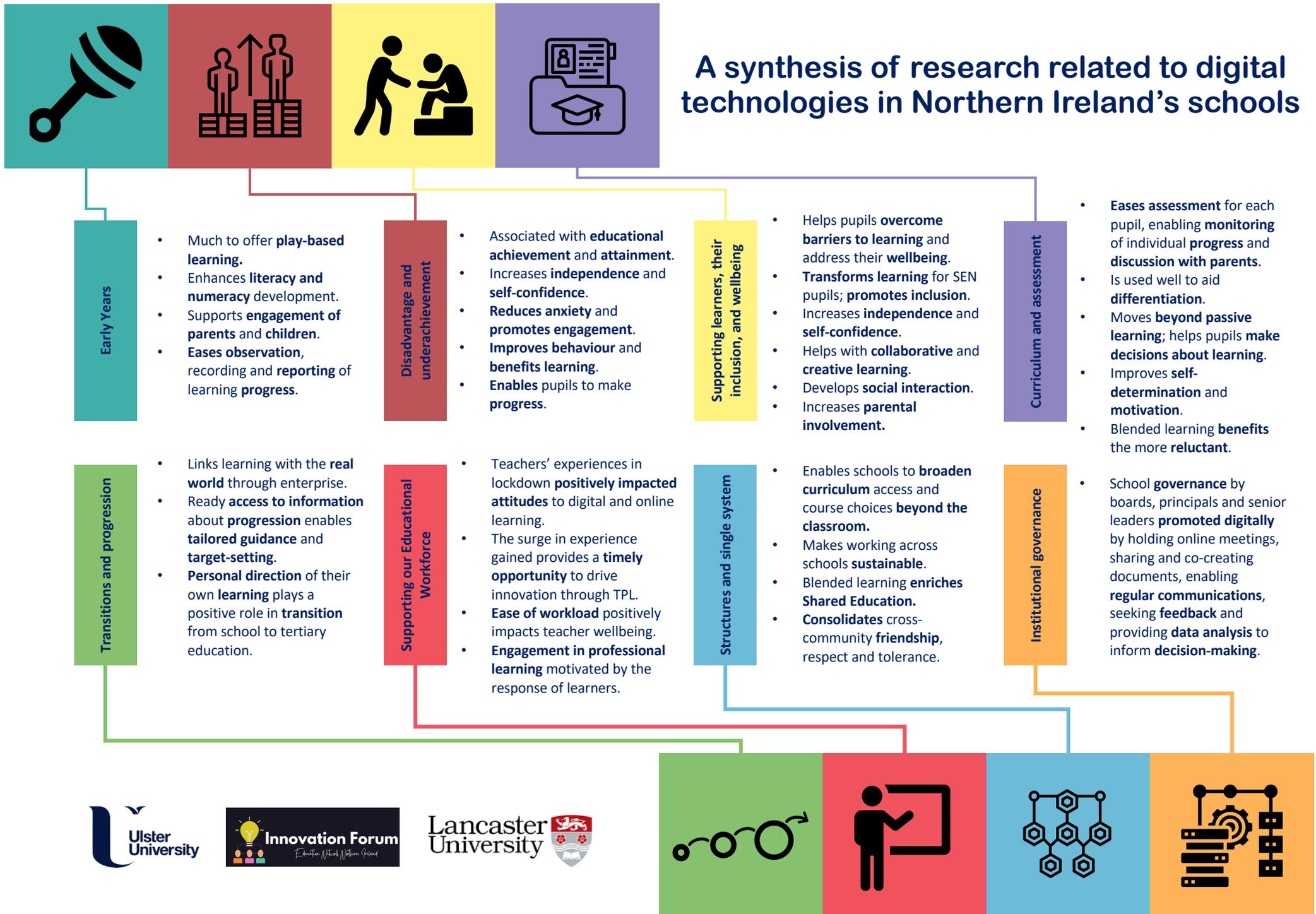
The evidence-based statements in this brief are affirmations, not assertions. Nevertheless, it is fair to ask: first - how widespread is the effective use of digital technologies across all Northern Ireland schools? and, second - how could such excellence become even more commonplace?

Section 4 sets out data relating to the use of C2k services by all schools in a specific month against a sample of schools included in this report. The evidence indicates, from the alignment of logins per pupil against high usage and effective practice, that it is highly likely that there are many schools across Northern Ireland that use digital technologies, widely, effectively, and innovatively. Future positive prospects for digital technology uptake and effective use are therefore strongly suggested. While the full extent of digital technology usage in all schools across Northern Ireland is not known at this time, what is known is that instances of effective and innovative practice continue to be recognised.

Section 5 summarises the conditions and characteristics of innovative digital practices which reviewers found to be flourishing; they point to short-term actions which could well be taken in schools wishing to benefit from the role digital technologies play in excellent, future-looking education. They may be read as a guide to what the Independent Education Review Panel may wish to recommend when considering ‘next steps’ to be taken across the school service to spread such practices even more widely.

Finally, **Section 6** looks ahead at what emergent technologies are offering, which are both potentially excitingly innovative and unsettling. The future with digital technologies is likely to provide a challenge to teachers and those who support them and may interfere with today’s comfort zone of classroom practices. However, the evidence of this report is that teachers, learners and education generally are adapting well to the challenges and opportunities of digital technologies. Further monitoring, research and development will be needed to ensure that innovation is not led by the technology, but by the instinct of providing for the very best interests and future needs of the learners.

A synthesis of research related to digital technologies in Northern Ireland's schools





***Early Years:** the importance of the early years of learning for a child's intensive brain development, offering a unique opportunity to improve their future learning*



Evaluation of practices in early year settings in Northern Ireland indicates that digital technologies **have much to offer to play-based learning** across the six areas of learning that comprise the early years curriculum, as well as **easing observation, recording and reporting of learning progress** and **enhancing engagement with parents**.

While there has been some historic resistance to the use of technology with young children out of concerns relating to developmental appropriateness, it has been found **“when educators are intentional and selective in its use, it has the potential to enhance children's literacy and numeracy development”** (Gray et al., 2017). However, Dunn and Sweeney (2018) caution against “assuming that all children are technophiles and want to learn with digital technology as this is not always the case” (Dunn and Sweeney, 2018, p.867). Instead, **the use of digital devices should be evaluated for its effectiveness in the given context** (Gray et al., 2017). Further research into implications in the different stages of early years' learning will be especially important as the provision of digital technologies increases in future years through the EdIS Programme.

When thirty-six early years children in key stage one, from six schools, were asked about their views of using mobile digital devices, researchers found that:

- They had **“a balanced view of the use of iPads in writing”** and were “aware of the traditional expectations of handwriting and spelling” (Dunn and Sweeney, 2018, p.867). They viewed using an iPad as a means of improving spelling by enabling them to identify incorrect words or choose alternatives (Dunn and Sweeney, 2018, p.867).
- They enjoyed “playful learning” and regarded using a tablet or certain apps as fun, an example of this being a child describing this as *“more funner than doing work”* (Dunn et al., 2018, p.825; Dunn and Sweeney, 2018).
- Choice was important to them, and they wanted to use apps that **“allowed them a sense of choice and creativity in their learning”** (Dunn et al., 2018, p.825) They enjoyed being able to change fonts and colour, and add photos (Dunn and Sweeney, 2018).
- It provided visual and verbal ways of communication (Dunn and Sweeney, 2018).
- Some enjoyed moving up levels and winning prizes within apps; this was not just a source of competition between pupils, but individual pupils enjoyed the “personal challenge and the sense of beating their own score” (Dunn et al., 2018, p.826).
- Producing work on an iPad could be quicker and more convenient than paper (Dunn and Sweeney, 2018) and if their hand got tired, they could use an iPad (Dunn and Sweeney, 2018).

- They had access to and regularly used tablet devices at home and **“saw their tablet use in and out of school as seamless, yet different”** (Dunn et al., 2018, p.824).
- They had “expert knowledge” about games they played on tablets at home (Dunn et al., p.825).

Teachers from twelve early years schools reported that using mobile digital devices:

- Was “not seen as work” by pupils, but as fun (Dunn and Sweeney, 2018, p.863).
- Increased motivation and engagement (Dunn and Sweeney, 2018; Gray et al., 2017).
- Because it is easier to edit work on an iPad, pupils are **“able to correct without looking like you are scoring out, like it is on paper”** (Gray et al., 2017).
- Helped engage boys in particular in writing activities (Gray et al., 2017).
- Has the benefit of giving children immediate feedback; however, this can be a drawback and lead to ‘trial and error’ (Gray et al., 2017).
- Gave more opportunities for choice and creativity (Dunn and Sweeney, 2018).
- Engaged **“a range of ability levels, including reluctant writers”** (Dunn and Sweeney, 2018, p.864).
- Helped with speech and language difficulties to record and listen (Dunn and Sweeney, 2018).
- In a mixed ability group, increased confidence and encouraged participation (Dunn and Sweeney, 2018).
- Was helpful for improving spelling (Dunn and Sweeney, 2018).

At the very earliest stages when children enter formal education, **digital technologies are being used by nursery schools to support engagement of parents and their children**, identified through an in-progress research study in four Northern Ireland schools.

Ways in which digital technologies are being used in these schools (Woodhouse, Passey & Anderson, In Progress) include:

- Providing parents and guardians with policy and information documents online.
- Creating videos that describe activities the children will be involved in, accessible for parents and guardians through QR codes.
- Sending parents and guardians regular images and video updates of their children’s engagement and progress.
- Enabling parents and guardians to support each other with online access.
- Gathering observational evidence of attainment and achievement to create individual portfolios of the child’s progress.
- Providing e-portfolios of children’s attainment and achievement that supports their transition to the foundation phase.



Evidence beyond Northern Ireland confirms that there is increasing interest in and evidence about the opportunities and benefits that digital technologies can offer for teachers and parents supporting learners in their early years.

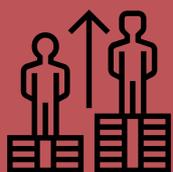
Zomer and Kay (2016), in a systematic literature review of research published between 2009 and 2014, examined evidence about uses of digital technologies to support learning in the areas of literacy, engagement, social interactions, mathematics, and miscellaneous topics, from across 11 countries. They concluded that: *“technology had a significant impact on literacy development. Fewer studies, mostly qualitative in design and small in sample size, reported that technology had a positive impact on engagement, social interactions, and mathematics skills. A handful of studies provided qualitative evidence that technology had a positive impact on sequencing, visual perception, creative thinking, and fine motor capability”* (p.1). In these cases, the digital technologies used were stand-alone pieces of software, e-books, hands-on devices such as interactive whiteboards or robotics, and online resources (p.6).

Support from digital technologies for early years literacy development of children was also reported in a literature review by Billington (2016): *“Technology can play an important role in supporting early communication, language and literacy by offering new opportunities, such as interactive and intuitive story telling e-books and apps, as well as other services, such as online video calling”* (p.4). Nurdiantami and Agil (2020) also reported outcomes for early years learners through a systematic literature review. They emphasised that whilst tablets were more popular compared to computers (as young children found them easier to operate), and with appropriate software and a supportive environment could be beneficial, nevertheless the use of technologies in some instances had negative consequences for health and the development of the children if use led to a decline in physical activity (p.258).

A more recent literature review (Wahyuningsih, Nurjanah, Rasmani, Hafidah, Pudyaningtyas and Syamsuddin, 2020) focused on STEAM (Science, Technology, Engineering, Arts, and Mathematics) education in early childhood learning. These authors identified a range of specific learning outcomes arising and concluded that *“STEAM makes children more active and able to take initiatives with their own knowledge... experience of STEAM can increase self-confidence in children”* (p.41).



⇒ By tendering to renew the C2k managed service, the EdIS Programme will extend the provision of ICT managed services into statutory pre-school settings for the very first time, bringing the advantages of a consistent and centrally funded managed provision into the early years, at no cost to a statutory setting. This will enable a personalised learning profile to be established for each child at the beginning of their education journey to inform all future interactions.



Disadvantage and underachievement: the aim is to commit to more far-reaching ways of tackling inequality and underachievement to raise standards, improve educational outcomes, wellbeing, the resilience of learners and enhance the life chances of all, as well as those from disadvantaged backgrounds who require greater support.



We know from evidence in Northern Ireland that **digital technologies, well used, are beneficial to learning** in a range of ways which include increasing pupil engagement, overcoming barriers to learning, increasing pupil independence and self-confidence, enhancing parental engagement and involvement, and aiding differentiation (Austin et al., 2022; Smith & Anderson, 2022; Education Authority, Northern Ireland, 2020; Passey, 2019a; 2019b; Smith, 2019, 2018, 2017, 2016, 2015; DE Circular 2016/26; ETI, 2012; Austin, 2004).

The use of digital technology is associated with educational achievement and attainment, in a range of studies (Austin et al., 2022; Passey, 2019a; 2019b) including in the judges' reports for the ICT Excellence Awards which consistently identify a positive impact and a direct relationship between the use of digital technologies and pupil achievement/attainment (Smith & Anderson, 2022; Smith, 2019, 2018, 2017, 2016, 2015).

Using digital technology can allow pupils to *“easily see how they had managed to work on something to get it right or wrong... increasing their self-confidence”*, enabling them to self-direct their response to feedback, enhancing their independence (Passey, 2019a, p.4). Evaluations of practice reveal that the use of **digital technology increases pupils' independence, self-confidence and reduces anxiety** (Austin et al., 2022; Passey, 2019a; Smith and Anderson, 2022; Smith, 2019, 2018, 2017, 2016, 2015). Pupils using a digital whiteboard in mathematics reported that the practice had been of benefit to them in reducing anxiety (Austin et al., 2022).

Furthermore, the use of blended learning in Life and Health Sciences resulted in every pupil (aged 16 to 18 years old), who engaged with online materials, achieving 85% and upwards; this occurred *“even if their face-to-face attendance was very low, e.g., 27%”* (Austin et al., 2022). In a different context, the use of Learning by Questions (LbQ) software (<https://www.lbq.org/>) has been recognised as having a role in promoting success: “LbQ had been used since October 2017 and was found to offer a positive stimulus for those who found it difficult to work with paper and pen. For other pupils, it was recognised that they could move forward using LbQ without needing to redo the things they might already know. In all cases, it was found that *“LbQ could provide pupils with instant success”* (Passey, 2019a, p.8). In one school, GCSE mathematics results increasing by 15% from the previous year (Passey, 2019a, p.11).

In a study of pupils using News Desk, a digital C2k resource allowing pupils to keep up to date with current news stories and to practice their reading and writing, it was noted that “all

pupils were engaged, they all had a wide audience for their work, but the boy whose story was on the front page *“was very strongly affected by the experience, to the extent that he now enjoys attending and working in school”* (Passey with Anderson, 2018, p.11).

Digital technology is used to improve behaviour and enable pupils to make progress when used in behaviour management. For example, digital technology has been:

- used as part of *“a rewards strategy helping to improve the achievement of Autistic youngsters with challenging behaviour”* (Smith, 2015);
- identified as having *“a significant positive impact on pupils’ attitudes towards their learning”* and has been reported to *“improve the opportunities of youngsters whose behaviour is challenging and for who this limits their ability to progress”* (Smith, 2016, p.15).



Evidence beyond Northern Ireland confirms that digital technologies are deployed in many countries and contexts to support pupils where disadvantage or underachievement are recognised.

A comprehensive international literature review explored how digital technologies can support specific learning outcomes (Yeung, Carpenter and Corral, 2020). They concluded that: *“technology is neither beneficial nor harmful for learning when used primarily as a means of presenting information (e.g., information viewed on a computer screen vs. on paper) but can be beneficial when it involves unique affordances that leverage effective learning principles”* (p.1583).

When activities ranging across video-based instruction, online courses, computer-assisted instruction, mobile devices, simulations, animations, digital games, and flipped classrooms were studied, positive learning outcomes were associated with uses that supported specific learning processes - repetition, retrieval practice, and spacing. The Department for Education in England (Sharp, Macleod, Bernardinelli, Skipp and Higgins, 2015) in a briefing paper to school leaders stated that schools that most successfully address the need to support pupils who are disadvantaged: *“seek out strategies best suited to addressing individual needs, rather than simply fitting pupils into their existing support strategies. These schools tend to provide both individual support for pupils that have very specific learning needs, and group support for pupils with similar needs”* (p.9).

In terms of disadvantage and achievement in the context of pupils with learning disabilities, a systematic literature review that explored uses of digital technologies (Dogan and Delialioğlu, 2020) identified that outcomes were often associated with uses of text-to-speech and speech recognition tools, graphic organisers and digital pens, manipulatives and flash applications. The authors concluded that: *“most of the articles [54 out of 57] showed positive improvements, whether statistically significant or not, in the skills related to reading, writing, and mathematics”* (p.14). Additionally, in a research report to the DfE, Edyburn (2020) stated

that: *“The right [assistive technology] AT augments, bypasses, or compensates for a disability”* (p.6).



- ⇒ A new Digital Learning Environment will provide access for schools to a wide range of integrated services such as learning applications and resources, online learning platforms, collaboration and communication tools, data analytics and the SMS. The ‘tell us once’ approach of the new modern solution will help to support effective collaboration and communication between pupils, parents, schools and the EA, minimising duplication and reducing the administrative burden for schools.
- ⇒ This system is underpinned by the supporting infrastructure incorporating the School Management System (SMS) with Data Insights, to support the implementation of the NI curriculum, provide evidence to support education policy and the development of skills for the workforce of the future. It will facilitate schools to more effectively identify underachievement, target interventions for individuals and groups of learners, and use evidence-based approaches to practice development. These tools will also support system wide planning and risk-based approaches to school improvement.
- ⇒ The move to a cloud-first SMS system will improve access for users from various device types and locations and will support multi-school-working through the sharing of relevant data for students and teachers.
- ⇒ EA Connect is a unified customer portal, which will become home to a number of key services delivered by EA to support schools and families. The first two services to launch on the portal are SEN Annual Reviews and Admissions. EA Connect simplifies processes and reduces the administration burden on schools, EA services and parents. It also enables close collaboration with all those involved in a child’s education journey. Additional services are expected in future development to include school transport and admissions for 14+ school applications.
- ⇒ EdIS is procuring a single online payment solution for all schools to meet the current and future needs of school leaders, teachers, pupils and families. The aim of the online payment system is to improve user experience for parents, facilitate the secure online collection of payments for school bills and reduce administration for school users. An online payment solution is currently in procurement stage with a tender award due to be announced in the coming months with a phased rollout to commence in 2023.



Supporting learners, their inclusion, and wellbeing: addressing and meeting the needs of young people with special education needs and prioritising emotional health and wellbeing of learners.



Evaluations in Northern Ireland demonstrate that **digital technologies well used are transforming the experiences of pupils with SEN**, through the ability to address the diverse, often complex, individual needs of pupils in order to overcome barriers to education and promote inclusion (Austin et al., 2022; Smith & Anderson, 2022; DE, 2016; Smith, 2019, 2018, 2017, 2016, 2015).

Digital technology use can help pupils overcome barriers to learning. Its use enhances engagement, supports special educational needs, aids differentiation, increases pupils' independence and self-confidence, reduces anxiety, and increases parental engagement and involvement (Austin et al., 2022; Smith & Anderson, 2022; Passey, 2019a, 2019b; DE, 2016; Smith, 2019, 2018, 2017, 2016, 2015; ETI, 2012; Austin, 2004).

The use of speech-to-text functions supports those pupils with dyslexia (Austin et al., 2022) and judges' reports from the ICT Excellence Awards have, since 2015, provided comprehensive details of how pupils with special educational needs are assisted in their learning, for example:

- The **use of robots to engage pupils** in one special school who had severe communications challenges (Smith, 2015).
- Digital technology **used to improve behaviour** and enabling pupils to make progress when used as part of a strategy for behaviour management (Smith, 2016, 2015).
- Digital technology being **used for independent and collaborative learning, creativity, imaginative play, social interaction problem solving and the development of fine and gross motor skills** (Smith, 2017).
- Digital tools being used **as part of each pupil's individual learning journey**, monitored through the use of digital personal learning journals, such as in Seesaw (Smith, 2019).

The Education and Training Inspectorate (ETI) recognised, through a joint evaluation report with the Department of Education and Skills Inspectorate from the Republic of Ireland, that in the Dissolving Boundaries (DB) programme, pupils with special educational needs were *"achieving well through the DB programme"* as **digital technology helps with inclusion and by addressing barriers to learning** arising from their individual special needs (ETI, 2012, p.8).

Digital technology is also used successfully to facilitate **the inclusion of, and engagement between, a school and pupils and families from the Traveller and Roma community** in a mainstream school with a significant proportion of children from those communities (Smith, 2016). As a result, attendance rates are reported as *"increasing dramatically"* as are the number of parents and families from these communities attending parents' evenings and other school events (Smith, 2016, p.17).

Whilst there are examples of effective practice in using digital technologies to support inclusion, opportunities for development remain. Inclusion can be supported by the use of assistive technologies so that pupils can engage in the widest possible range of learning tasks. Yet, in a study with over 1,300 teachers from primary, post-primary, Irish Medium, Special and EOTAS provision, Taggart (In Press) identified that 73.03% of respondents had *never* used any of the identified assistive technologies in their classroom. These included screen reader software, word prediction tools and alternative keyboards. It remains unclear if this underuse is linked to the availability of resources, an absence of need or a requirement for related professional learning linked to the provision and use of assistive technologies to promote inclusion.

Developing further approaches to inclusion, innovative digital applications are currently being trialled in local schools that support children and young people in understanding triggers for their anxiety. A heartbeat monitor connected to an app (TakeTen⁹) provides feedback on physical stress indicators and supports users to regulate the impact.



Evidence beyond Northern Ireland confirms that digital technologies can be used to address inclusion and support wellbeing.

As the UNESCO International Institute for Education Planning (2021) stated:

*“Persons with disabilities are two and a half times more likely than their peers to have never attended school. Technology is often an asset for bridging this learning gap and achieving inclusive education for all.”*¹⁰ In the literature, there are specific examples of how inclusion using digital technologies is being achieved. For example, a case study in England (DfE, 2019) states that: *“All students with learning difficulties are supported to use a computer in class and for summative assessments. Students can then take advantage of the built-in accessibility features of modern word processing software to overcome difficulties with handwriting, reading and spelling. These features allow students to type legible text quickly, spell-check errors and read text out loud. Text-to-speech enables students to listen to assessment questions/instructions and proofread their answers”* (p.10).

Rafi (2021) goes further, indicating how both inclusion and wellbeing can be addressed and supported by digital technologies: *“Many students with disabilities face physical barriers to access education, as many schools lack the facilities needed. Travelling to and from school can be challenging not only for students using wheelchairs, but also students with autism who are more sensitive to sound and light, which can make public transport (and classrooms) very stressful. Edtech gives access to education from the comfort of their own homes, where it is easier for them to be cared for by family members.”*¹¹

⁹ https://play.google.com/store/apps/details?id=com.letstaketen.mobile&hl=en_GB&gl=US&pli=1

¹⁰ <https://www.iiep.unesco.org/en/inclusive-education-overcoming-barriers-technology-13705>

¹¹ <https://blogs.lse.ac.uk/businessreview/2021/08/09/technology-promotes-inclusion-for-the-worlds-largest-minority-group-people-with-disabilities/>



- ⇒ A digital Case Management system will enable the tracking and storing of pupil information in a centralised location. It will be accessible to a variety of users to ensure collaboration on case management and the sharing of information in a secure environment. Crucially, pupil data will follow the learner throughout their education journey and be accessible to stakeholders, with access permissions, to view, review and where appropriate update it.
- ⇒ A renewed School Management System across schools, is designed to improve the management and flow of data between schools, parents and EA support services and to support multi-school collaboration.
- ⇒ Secure and flexible access to a centralised record system, along with automated processes, will reduce the administrative burden and provide ready access to information that supports each learner throughout their educational career.
- ⇒ The School Management System will also provide tools to complete statutory and business critical processes and support schools in identifying trends, prioritising resources to informing planning to result in targeted interventions for the learner and enhance their learning experience.
- ⇒ A Child Protection Case Management System will provide centralised records that contains secure recording of, and access to, relevant safeguarding data relating to a child/young person at risk of significant harm. The system will include concerns, plans, and actions for case management and will record allegations of abuse against staff, including a robust reporting function. This project covers the statutory requirements of dealing with disclosures or staff concern(s) of abuse/neglect that have been triaged and warrant the creation of a Child Protection File.



4 Curriculum and assessment: curriculum, pedagogy and assessment are central, should be coherent, continuous, and learner-centred; learners should develop as individuals, contributors to society and contributors to the economy; assessment should help the learner to improve and recognise what has been learned. Abrupt transitions should be minimalised and young people should be able to choose from a number of pathways.



Evaluation of practices in Northern Ireland evidences **the use of digital technology for the easier implementation of assessment for each pupil** (Austin et al., 2022; Taggart et al., 2022; Passey, 2019a; Galvin et al., 2010; Smith and Anderson, 2022; Smith, 2019, 2018).

The ease of access to assessment data about pupils' achievements enables teachers to monitor the progress and engagement of individual students, allowing them to more effectively tailor advice and use this information in partnership with pupils to set attainment targets (Taggart et al., 2022; Passey, 2019a; Galvin et al., 2010).

Digital technology aids differentiation in teaching and learning. *"It was very clear that technology was an essential component of ensuring differentiation in many schools, and **not just in meeting the needs of those with learning difficulties, but in meeting the additional needs of the gifted and talented and providing stretch targets for the many**"* (Smith, 2017).

Taggart et al. (2022) found that for some primary school pupils having knowledge about their progress and being able to set their own targets led to improved self-determination and motivation. In an early-years setting, a nursery school is developing (Woodhouse, Passey and Anderson, In Progress), ahead of the provision of a standard school management system for all grant-aided nursery schools, innovative means of recording, analysing and reporting observations made by the adults about the progress of young children across the six areas of learning of the early years' curriculum.

In terms of the value of assessment through these means, pupils engaging in a programme of blended learning have provided feedback that **"they appreciated the ongoing support, the way that errors were picked up early on and the way that the blended learning helped them to meet the weekly deadlines"** (Austin et al., 2022).

Additionally, digital technology can enhance better engagement of the learners (Austin et al., 2022; Smith & Anderson, 2022; Passey, 2019a, 2019b; S Smith, 2019, 2018, 2017, 2016, 2015). Teachers have reported that *"introducing technology projects has gone well beyond just exciting and engaging their interests, increasing levels of enthusiasm so that they are no longer passive learners, but are leveraging other learning gains" such as making decisions about when and where to use different technologies* (Smith, 2017, p.2). Research has also shown that digital technology benefits those pupils who may find it difficult to work with paper and pen (Austin et al., 2022; Passey, 2019a; DE, 2016; Austin, 2004).

Using digital technology can allow pupils to *“easily see how they had managed to work on something to get it right or wrong... increasing their self-confidence”*, enabling them to self-direct their response to feedback thus enhancing independence (Passey, 2019a, p.4).

Digital technology can also be used to enhance parental engagement and involvement, encourage them to monitor and discuss their children’s attainments and achievements and enhance homework practice (Innovation Forum, 2022).

Blended learning online

When working online, pupils who tend to be shy and unwilling to engage in classroom debate provided enhanced responses in the online environment. In an online, blended learning discussion about a literature text, the teacher noted the following key points:

- *“Positive impact upon the more reluctant contributors to discussion in class;*
- *“Pleasing tone of courtesy and challenge when interaction took place;*
- *“Thoughtful and nuanced responses were evident in everyone’s contributions;*
- *“Sustained evidence of independent learning; and*
- *“Negligible impact upon workload”*. (Austin et al., 2022)

Passey (2019a) similarly noted that discussion online also serves to highlight *“the silent pupils”* enabling them to be supported (p.7).

When working online, *“differentiation is (also) supported”*, as different question banks can be set up, and pausing to discuss issues with specific groups does not affect the progress of others. Teachers can *“easily choose questions to match needs of different pupil sets”* (Passey, 2019a).

As a consequence of more prolonged blended learning approaches, post-primary schools report an increase in the numbers of children and young people refusing to attend school for all or part of the week. Several schools are using blended learning to support continuity of learning for such pupils. One school reported that in some cases the performance of pupils (with 50% or less attendance) availing of blended learning approaches is higher than those learning in the classroom (Personal email: 24 February 2023).

In this context, digital technology can increase pupils’ independence, self-confidence and reduce anxiety (Austin et al., 2022; Passey, 2019a; Smith and Anderson, 2022; Smith, 2019, 2018, 2017, 2016, 2015). Using digital technology can allow pupils to *“easily see how they had managed to work on something to get it right or wrong... increasing their self-confidence”*, enabling them to self-direct their response to feedback thus enhancing independence (Passey, 2019a, p.4).

Using ICT

ICT capability itself (UIC¹²) has been noted as not well handled at transition/school transfer, with growing levels of dissatisfaction and frustration, particularly amongst primary pupils transferring with the *“expectation that the use of technology will be seamlessly*

¹² <https://ceea.org.uk/key-stage-3/curriculum/using-ict>

embedded into teaching and learning at their destination post primary” (Smith, 2019). ICT Excellence Awards judges identified evidence of this being the case in NI since 2016 and repeatedly described this as a significant issue (Smith, 2017, 2016). However, the 2018 and 2019 ICT Excellence Awards judges’ reports noted **some schools as working to address this issue but emphasise there is still much to be done** (Smith, 2019, 2018).

More recently, evidence from school study visits (Smith and Anderson, 2023) indicates that the responses which schools made to the challenges of teaching remotely during the Covid-19-pandemic has accelerated fundamental changes, most notably a deeper, more sustained embedding of the use of digital technologies as a means of learning in the classroom and at home, which moves well beyond short, timetabled sessions of teaching the skills of ‘Using ICT’.



Evidence beyond Northern Ireland confirms that digital technologies are being used to develop curriculum and assessment practices in schools. Whilst there are many published examples of how countries have introduced digital technologies into their curricula (for example, Australia¹³, New Zealand¹⁴, Uruguay¹⁵), the integration of digital technologies to support assessment appears to be less well developed at this time.

However, in the United States (US), the National Center for Education Statistics (2022) is transitioning to digital assessments: *“NAEP digital assessments, which are administered on tablets or laptop computers, use dynamic and innovative technologies to provide an engaging assessment experience for students and more meaningful data about students’ skills and knowledge for educators. With digitally based assessments, students are asked to receive, gather, and report information just as they do in their everyday lives.”*¹⁶

Blundell (2021) reviewed the international research literature about how schools are using digital technologies to support assessment practices and concluded that: *“automated marking and computer- and web-based assessment technologies support established school-based assessment practices, and that game-based and virtual/augmented environments and e-portfolios diversify the modes of assessment and the evidence of learning collected. These technologies improve the efficiency of assessment practices in teacher-centred pedagogies and provide latitude to assess evidence of learning from more diverse modes of engagement in student-centred pedagogies”* (p.279).

¹³ <https://www.educationmattersmag.com.au/digital-tech/>

¹⁴ <https://ncea.education.govt.nz/technology/digital-technologies?view=subject-glossary&refinementList%5Bcurriculum%5D%5B0%5D=NZC&refinementList%5Bsubject%5D%5B0%5D=Digital+Technologies&refinementList%5Bsubject%5D%5B1%5D=Common&refinementList%5Btype%5D%5B0%5D=Subject+Specific>

¹⁵ <https://blogs.worldbank.org/edutech/remote-teaching-uruguay>

¹⁶ <https://nces.ed.gov/nationsreportcard/dba/>

While in Northern Ireland the GCSE examination in Moving Image Arts has been conducted successfully online for some years, a UK examination board is also trialling use of online examinations: *“Thousands of students in England will sit on-screen tests this year in a major pilot run by AQA, the country’s largest exam board, marking a big step towards online exams.”*¹⁷



The EdIS education environment will include:

- centralised services to provide storage and computer facilities for schools;
 - identity services ensuring appropriate and authorised access for users; and
 - security services to protect schools’ and users’ information, assets and services.
- ⇒ The key component will be an integration platform which will ensure that all services and systems integrate seamlessly, providing school staff and learners with an interoperable end-to-end solution.
- ⇒ The NAACE¹⁸ Self Review Framework provided to all, helps schools, at no cost to their budget, to maximise the adoption of technology, supporting several areas including:
- The impact education technology has in a school;
 - How outcomes are improving through engagement and essential digital skills;
 - Availability of high-quality professional learning resources; and
 - Safe and secure use of technology assurance.
- ⇒ A Library Management System will support a holistic approach to curriculum delivery and literacy development for all schools and EOTAS centres. Pupils, librarians, and teachers will become part of an online, collaborative community that supports lifelong learning and fosters a love of reading. The innovative functions of the system will streamline processes such as circulating resources, auditing stock and reporting trend analyses throughout the Education Library Service provision in Northern Ireland.
- ⇒ A Music Management System will provide a centralised solution to integrate both operational and educational requirements within the EA Music Service. Streamlined administrative processes around tuition, payment, and stock management will enhance efficiency and a robust reporting function will support Music Service development and innovation into the future. Music staff will also be given access to relevant pupil information to facilitate differentiation to suit the individual needs of their learners.

¹⁷ <https://schoolsweek.co.uk/online-gcses-by-2025-as-aqa-launches-major-pilot/>

¹⁸ The Educational Technology Association



Transitions and progression: addressing those who become disengaged; transition from school to further education, training, or employment.



Evaluation of practice in Northern Ireland illustrates **the positive role that digital technology can play in helping young people transition from school into further education, training or employment** (Smith and Anderson, 2023, 2022; Smith, 2019, 2018, 2017, 2016, 2015).

The ease of access to online information about pupils' educational progression enables teachers to monitor the progress and engagement of individual students, allowing them to more effectively tailor advice and use this information in partnership with pupils to set attainment targets to support their progression.

Real-world experiences

The use of digital technology also enables education to link with the real world, for example, with businesses outside the school **through enterprise projects** (Austin, 2011, p.10). The programme involved twenty schools in total, ten in Northern Ireland and ten in the Republic of Ireland comprising both primary and secondary schools. Working together on a common project using ICT, pupils developed key skills such as communicating, listening, flexibility, staying power, respect, and tolerance as well as enterprise (Austin, 2011, p.23, p.43). These gains have been identified by the Dissolving Boundaries programme, which has also highlighted the importance of **developing the skills of communication and teamwork**. Data gathered by schools engaging in this programme repeatedly showed "greater self-confidence" as one of the most important outcomes reported by pupils (Austin, 2011, p.23, p.27, p.43).

Developing agency as a learner

Digital technology allows for independent, anywhere, anytime learning which can support pupils from 10 years of age who have become disengaged from education, given their access to the Internet and a mobile device (Passey and Zozimo, 2016; DE, 2016).

For example, the technology-enabled learning strategy employed by one school was described as being *"far more successful in preparing the school's students for the next step of university or employment, as they were far more able to direct their own learning – exerting influence over what and how they learned, how work was recorded, how work was presented and so on"* (Smith, 2016). Similar outcomes have been reported in judges' reports since 2015.

The judges' report in 2018 referenced the opinions of parents in a winning school on transition: *"Parents of current pupils who had seen older siblings progress to high performing higher education institutions... reported the transition had been relatively easy for their child because the style of learning and teaching in use at [name of school] had prepared these older pupils extremely well for higher education"* (Smith, 2018, p.9).

Commenting on ‘Independent learning and those who thrived’, the judges reported: *“there could be little doubt, either, some of the young people were happy to say that, with the exception of the social interaction element with peers particularly, they had thrived under the remote learning scenario, and, among the A-Level students, there was a general feeling that they felt far better equipped for tertiary education”* (Smith and Anderson, 2022, p.24).



Evidence beyond Northern Ireland indicates that many countries use digital technologies to support pupil transitions and progression. The BBC shows the use of video recordings to raise awareness of new contexts when pupils transition from primary to post-primary schools.¹⁹

Schools across countries are themselves developing websites to support parents and pupils with transition, for example, the Swiss International School Dubai.²⁰ When pupils move to post-secondary school, a research study of a school transition in Norway (Strand, 2020), reported that: *“On a weekly basis, the teachers [in the post-primary school] communicated with the parents using a digital communication application. At the request of the parents, they began sharing the students’ plans for homework with the parents some time after school started”* (p.138). In terms of using digital technologies to support progression, there are examples of practices used in a number of countries.

Outcomes of using a tracking system is reported by the DfE in England²¹, the Scottish Government in their national strategy ask teachers to *“Ensure that digital technology is a central consideration in all areas of curriculum and assessment delivery”*, while Gonzales (2022) reports how pupil progression in mathematics was measured and monitored using hand manipulatives and touch screen applications.

¹⁹ <https://www.bbc.co.uk/teach/transitioning-to-secondary-school/zkc9pg8>

²⁰ <https://sisd.ae/transitioning-from-primary-to-secondary-school/>

²¹ <https://www.gov.uk/government/case-studies/measuring-pupil-progress-and-managing-the-data>



Supporting our Educational Workforce – a commitment to excellent teacher education; teacher professional learning, including mentorship as pre-requisites for educational improvement.



Evaluation of practices during the Covid-19-pandemic in Northern Ireland, revealed that **teachers’ experiences of lockdown had a positive impact on their attitudes to the development of their digital skills and to online learning.**

The impact led, in cases researched, to a surge in uptake of digital technologies within schools... the experience gained by teachers during subsequent lockdowns presents a timely opportunity to build upon what has been learned (Taggart et al., 2023a; McCaffrey-Lau et al., 2020).

McCaffrey-Lau et al.’s (2020) study reported 76% of respondents to a survey (n=464) were “*more likely to engage with online learning*” and 93% (n=569) were “*more likely to advocate for professional digital skills training for teachers*” (p.7). Such positivity provides a favourable situation on which to develop the aim contained in the Learning Leaders’ Strategy, the Department of Education’s (DE) plan for teacher professional learning, that of empowering “the teaching profession to strengthen its professionalism and expertise to meet the challenging educational needs of young people in the 21st century” (DE, 2016, p.4). Lack of capacity to support the development of digital education has been identified as needing to be urgently addressed to support the “*development needs of teachers to provide an inclusive digital education*” (McCaffrey-Lau et al., 2020, p.61; DE, 2016).

Furthermore, teachers’ experiences during the pandemic in relation to digital technology have been described as having “*the potential to provide invaluable, positive contributions to the redesign of policy development, planning and future teacher support with regards to the development of digital education*” (McCaffrey-Lau et al., 2020, p. 60). Researchers believe this “*could ultimately lead to unlocking and driving innovation and improvement for learners across Northern Ireland for generations to come*” (McCaffrey-Lau et al., 2020, p. 60). However, success with the use of digital technology “*...depend(s) upon the understanding and ability of teachers to make informed decisions about the values and potential (the ‘affordances’) of the software curriculum resources used to support effective pedagogical practice in their own context*” (Passey with Anderson, 2018, p.17).

Defining teacher competence

Taggart (In Press) further concludes that there is work to be done to support this improvement through a reimagination of the General Teachers’ Council (Northern Ireland) Teacher Competences, specifically Competence 11. Whilst it “*outlines how teachers should incorporate “technology” into their learning and teaching activities*”, overall, the framework fails to include many of the key issues that impinge positively and negatively on education including:

- teacher and learner digital wellbeing;
- online safety and cyber resilience;
- the need for better understanding of the benefits of blended and collaborative learning; and
- a better understanding of the efficiencies gained through whole-school approaches to data and administration. (Taggart, In Press, p.88)

Benefits to teacher wellbeing

A range of studies reveal how **engaging with digital technology can positively benefit teacher wellbeing by easing teacher workloads in a variety of ways** (Taggart et al., 2023; Taggart, In Press; Taggart et al., 2022; Passey, 2019a, 2019b; Austin, 2011; Austin et al., 2010).

The ways in which digital technology has been reported (Taggart et al., 2023b; Taggart et al., 2022) to benefit teacher wellbeing include:

- Through enabling **supportive collaboration** with colleagues and providing pupils with the **opportunities to access their classwork more independently**.
- By allowing **more mobility**, for example, being able to use their own smartphone to access emails.
- Through **facilitating the tracking of pupil assessments and progress**.
- Through being used to facilitate **parental engagement**.

Taggart (In Press) identifies that nearly 70% of teachers studied reported how educational technologies contributed positively to their workload, with a further 12.9% reporting that they felt it may do so in the future. Similarly, 45.9% reported that educational technologies contributed positively to their wellbeing with more than 1 in 5 teachers indicating that they felt it may do so in the future.

Additionally, Passey (2019a, 2019b) found improvements in wellbeing:

- By significantly **reducing the time spent on marking and planning**.
- Through **aiding differentiation**, enabling more time to focus on individual and group support and progress monitoring.

Furthermore, benefits arose by **reducing stress and high levels of emotional concern** for those pupils experiencing difficulties engaging/understanding/completing what is being taught (Taggart et al., 2023b; Taggart et al., 2022; Passey, 2019a, 2019b).

*“Overall, pupil and teacher behaviours are being shifted as a result of using [Learning by Questions] LbQ; there are cognitive, social and emotional shifts in both pupils and teachers. Cognitive shifts are concerned with enhanced subject and topic activity on task; social shifts are concerned with enhanced peer teaching and enhanced teacher monitoring; while **emotional shifts are concerned with more positive teacher wellbeing and more open pupil support for others**” (Passey, 2019a, p.11).*

Learning to use digital technologies

The Education Authority (EA) found that the challenges of Covid-19 and remote learning created a demand for focused professional learning to develop skills in using digital technology to support learning (as well as other aspects such as outdoor learning, trauma-informed practice and learner-centred approaches). In response, EA developed a variety of online programmes in which several hundreds of teachers participated. Subsequent feedback (EA, Unpublished) in 2022 from teachers indicated that changes in practice were informed by engagement and the opportunity to collaborate with others.

Similarly, since 2021, “TPL Thursdays”²² have become a regular EA-provided feature of professional learning with teaching staff, ranging from 50 to 300 in number, joining 30–40-minute webinars after school, engaging with other practitioners and sharing aspects of their pedagogic practice.

Learning how to engage with digital technologies, specifically Virtual Reality (VR) has the **potential to support how teachers approach the teaching of controversial issues and promote reverse-mentoring opportunities between in-service teachers and those in initial teacher education**. Taggart et al. (2020) report on work with twenty-one pre-service teachers to explore their perceptions of contested spaces in Northern Ireland. The study set out to increase awareness of shared experiences, promote empathy for historical events, and help eliminate spaces of fear. The study found that **curated VR experiences produced emotional responses that helped participants counter partisan narratives of the past**. Farrell et al. (2022) report how this project used a combination of cognitive apprenticeship and reverse-mentoring to explore the pedagogical and systemic benefits of VR engagement across the island of Ireland and beyond.

This work is complemented by a curriculum and teacher professional learning-focused Virtual Reality in Initial Teacher Education (VRITE) project, a SCOTENS²³-funded project, which considered how emerging VR technologies could be used to support both pre-service and in-service teacher learning.



Evidence beyond Northern Ireland shows how digital technologies are being used widely to support teacher professional development (TPD).

A literature review by Hennessy, D’Angelo, McIntyre, Koomar, Kreimeia, Cao, Brughá and Zubairi (2022) explored outcomes from 170 studies across 40 low- and middle-income countries (LMICs). The authors reported that:

“Promising, locally contextualised forms of technology-mediated TPD included virtual coaching, social messaging, blended learning, video-stimulated reflection, and use of subject-specific software/applications” (p.1), but the authors cautioned that: *“The role of TPD*

²² <https://www.eani.org.uk/tpl-thursdays>

²³ Standing Conference on Teacher Education, North & South (SCoTENS) a network of teacher educators across Ireland.

facilitators/coaches emerges as paramount, although research on how tech can support these pedagogical leaders is sparse” (p.24).

Minea-Pic (2020), in an OECD Working Paper, adds that: *“Existing studies tend to suggest that the principles and features that enhance the effectiveness of traditional professional development can also guide the design and assessment of online teacher professional learning”* (p.11). But the author also states that: *“An inventory of innovative practices of teacher professional learning analysed in relation to the key features of effective professional development, (Vuorikari, 2019) shows that all identified practices rely on active learning, and a great number of them are based on modelling effective practices and support collaboration in job-embedded contexts”* (p.12).

An Economist Intelligence Unit report (Staff of 2030: Future-ready Teaching, 2020) explores how teaching may change by 2030. The report concludes that: *“The new generation of educators is largely aligned with the need for innovation in teaching and learning. At the same time, they seek greater support in key areas like dealing with burnout and stress, using digital technology for teaching and enabling diverse learners. For some, their optimism about the impact of innovation, technology and teacher excellence on student outcomes—and societal views on the prestige of their profession—fade over time, though this is far from inevitable. Addressing these issues will be crucial as teaching—perhaps more so than many other professions—is at a turning point”* (p.21).



⇒ through nearly £20 million funding provided by the Department of Education, EdIS provided more than 21,000 new Microsoft Surface Pro 7 Plus devices to all teachers in more than 1,100 schools across Northern Ireland.

⇒ in partnership with Capita and Microsoft, C2k have launched a teacher professional learning initiative to engage school leaders and teachers to maximise the use of the new teacher devices recently rolled out to schools to support teaching and learning; co-designed and co-created resources and support are being provided through teacher professional learning workshops.

⇒ EdIS will deliver a platform to facilitate the professional development of teachers and enabling networking and collaborative learning. It will build on the Learning Leaders policy to build networks and a hub for sharing practices.



Structures and single system: education should be ‘delivered in collaboration, not in competition – with the needs of the learner paramount.’



Evaluation of practices in Northern Ireland demonstrates that the use of **digital technology enables schools to broaden their curriculum and contacts beyond the classroom through the establishment of “virtual spaces”** (Taggart et al., 2022; Taggart et al., 2020), providing a potential foundation for sharing online courses and programmes of study across schools.

Lessons from shared education through blended learning

Digital technology has been successfully used for shared education **using blended learning** to allow children from different schools and backgrounds to work together on areas of the curriculum to create an end-product (Austin et al., 2022; Taggart et al., 2020).

Austin and Turner’s research (2020) was the first empirical study into the use of **Blended Learning in Shared Education**. Reporting on work involving 144 teachers and research in fifty-one primary and three post-primary schools, they reported that, whilst reconciliation and handling controversial issues were regarded as having been least affected by their Shared Education work, **blended learning had made impact** through:

- the development of cross-community friendships;
- preparing young people for the diversity of workplaces;
- making progress towards ‘normalising relations’ between pupils;
- developing a respect for difference; alongside enhancing pupil outcomes by:
- improving ICT skills; and
- improving attitudes towards learning.

Three main practical advantages identified by teachers who participated in the Dissolving Boundaries programme are that:

- digital technology enables the frequency of meetings to occur in ways that would not have been possible if they had been face-to-face;
- digital technology makes the programme more sustainable, circumventing transport costs and damage to the environment; and
- the vital role of digital technology enabling interaction to occur between schools helped schools strengthen their use of digital learning (Austin et al., 2022).

Austin et al. (2020) reported on the affordances of digital technologies in support of blended learning as a **“sustainable and affordable”** model (p.31) to affect systemic change through Shared Education. They concluded that with clear leadership from principals in normalising links between schools over extended periods of time, blended learning had the capacity for pupils with different learning needs to be treated as equals and participate fully in linked work. Furthermore, they asserted how, over time, **teachers can progress to make informed**

choices about how to develop face-to face and online work to build trust amongst pupils across schools. Working together online provided pupils with a common focus and while, in one study, pupils and teachers were not using the language of reconciliation, the **pupils developed key skills including those of respect and tolerance and friendships** (Austin, 2011, p.23).

It is known that teachers respond well to the introduction of blended learning approaches. Of 71 teachers attending five sessions provided by the Creative Learning Centre in Armagh, *“93% said they acquired new skills, resources and blended learning approaches for Shared Education; 90% said that the workshop gave a creative planning approach that will enrich learning and engagement with their Shared Education partnerships”* (AJA, 2021, p.53).



Evidence beyond Northern Ireland confirms that schools in other countries and contexts are exploring virtual, shared site and multiple site provision using digital technologies. The literature tends to focus on virtual schools and virtual teams, both relevant in the developing context in Northern Ireland.

Barbour and Reeves (2009) explored concepts and definitions of virtual schools. They highlight the key benefits, but caution that these will only arise if engagement and activities are managed effectively: *“expanding educational access, providing high-quality learning opportunities, improving student outcomes and skills, allowing for educational choice, and achieving administrative efficiency”* (p.413).

Ofsted (the inspection service in England) reported more specifically on the impacts of virtual schools that supported looked-after children. They concluded that: *“Overall, there was evidence of improving educational outcomes for looked after children in all local authorities visited. Improvement was not limited to attainment, but there was also good evidence of increased levels of attendance and reduced numbers of exclusions. Furthermore, in many cases, improved educational achievement had considerably enhanced children and young people’s sense of self-worth and had provided some much-needed stability in their lives”* (Ofsted, 2012, p.6).

A literature review that examined outcomes of diverse pupil groups in virtual schools across the US (Blazer, 2009) reported that: *“Virtual schools appeal to students from both ends of the achievement spectrum. The self-paced nature of online courses provides remedial alternatives to students who have failed in traditional courses, but also enables advanced students to accelerate their studies according to their own abilities”* (p.1). However, success with virtual (or hybrid) classes can depend very greatly upon the management of virtual teams.

Morrison-Smith and Ruiz (2020) undertook a literature review of barriers and challenges in this context, and although many sources were beyond the school age range, the findings are nevertheless pertinent to the school context. They highlighted the need, when required, for

teachers to manage reduced motivation, awareness and difficulty of establishing trust, recognising barriers to informal and face-to-face communication, having appropriate technical infrastructure, handling intra-team conflict, and managing the dimensions of common ground, socio-cultural distance, and lesson culture.



⇒ Through a £485 million tender for a Strategic Partner Services and School Management System (SMS), the EdIS Programme, will provide a transformational change programme to support learning for children and young people into the mid-2030s.

- ⇒ The Strategic Partner will provide services including an SMS for Nursery, Primary, Post Primary, Special schools and EOTAS centres; and will deploy, support, and manage a modern architecture, technical infrastructure, and secure services for schools. These services will be designed to improve the learning experience of young people, support teaching through technology, develop skills for the future, support programmes to improve educational outcomes, facilitate professional learning for teachers and support the EA and its education stakeholders to improve educational outcomes.
- ⇒ Innovation is integral to the role of the Strategic Partner, ensuring Northern Ireland schools have access to the latest education technology throughout the term of the contract.
- ⇒ All primary, post-primary, SEN and EOTAS schools and EA sites have an upgraded broadband solution resulting in a significant increase in bandwidth, preparing the foundations for future EdIS services.
- ⇒ Nursery schools will be provided with upgraded broadband enabling high quality connectivity for the first time in early years settings to ensure access to future EdIS services.
- ⇒ The EdIS Wireless Project will replace the existing C2k wireless in schools and will form the largest single Cisco Meraki Wi-Fi deployment ever delivered in Europe. It will give much improved internet access throughout teaching and common areas in the school via a wide range of devices. This enhanced connectivity will also improve the local area infrastructure in preparation for future services.



Institutional governance: increased delegation of decision-making to schools, along with appropriate support, will help to deliver better outcomes for learners; all educational institutions need to see themselves as accountable to learners and to society.



From evidence in Northern Ireland, in terms of school governance by boards of governors, principals and senior leaders, **digital technologies are now being used for a range of purposes, including holding meetings, sharing and co-creating documents, enabling regular communications, seeking feedback and providing data analysis to inform decision-making.**

Institutional governance can be considered at (at least) two levels: the governance role of the school governing body; and the governance role of the principal and senior leadership team. In both cases, school visits (Smith and Anderson, 2023, 2022) have highlighted how schools are using digital technologies to support their needs in these respects.

In terms of school governing bodies, digital technologies are now being used to (Smith and Anderson, 2023, 2022):

- Hold school governing body meetings.
- Hold regular meetings to support school governing body involvement with the school and with individual teachers and senior leaders.
- Hold repositories of documentation and policies.
- Enable shared creation and comment on documentation in progress.
- Enable communication as and when required.
- Provide feedback on a regular basis.
- Provide data analysis outcomes for discussion for decision-making.

In terms of the governance role of the principal and senior leadership team (in nursery as well as primary and post-primary schools), digital technologies are now being used to (Smith and Anderson, 2023, 2022; Woodhouse, Passey and Anderson, In Progress):

- Hold repositories of documentation and policies.
- Enable shared creation and comment on documentation in progress.
- Enable communication as and when required, with teachers, parents and pupils.
- Gather feedback from pupils, parents and teachers.
- Monitor progress as required.
- Provide feedback on a regular basis.
- Provide data analysis outcomes for discussion for decision-making.

School visits are revealing that, through uses of digital technologies, data are being more regularly collected, communication is happening more frequently and more effectively, and greater time for discussion (rather than for data gathering or processing) is supporting positive ethos and collaboration. Involvement of parents is increasing in cases observed, and while this outcome is recognised as being particularly valuable, there has been need for

schools to consider how to effectively manage teacher wellbeing when communication demands might become overwhelming.



Evidence beyond Northern Ireland confirms that digital technologies are being used to support institutional governance increasingly. Uses of digital technologies in this context are not new.

Williamson (2016) indicated that: “From large-scale, longitudinal datasets to school-level administrative data, and to real-time big data systems, digital technologies are playing an increasing role in the administration of educational data, and in the organization of classrooms and online courses” (p.4).

During the same year, Selwyn (2016) reported on the ways that digital technologies were supporting institutional governance in two schools in Australia. The author concluded that: “Our investigations found digital data to have been established within these Australian school contexts as a key tool of self-evaluation, comparison, accountability and means of sustaining managerial forms of governance” (p.65). Concerns raised by these authors at that time are still present, but undoubtedly the ways that digital technologies are being used to support institutional governance have in some contexts shifted in parallel to the development of the digital technologies themselves.

Nwoso and Chukwuere (2017) explored such challenges and opportunities for governing bodies of using digital technologies in South African schools. The authors found that it was necessary for school governing bodies to consider how digital technologies could support a range of needs. Specifically: “*Maintain and monitor school policy; Control school finance; Design school curriculum, calendar and school rules as well as determining the mission and vision of the school; Maintain and monitor school properties; Create a good link between the members of the school and the [school governing body] SGB*” (p.13). As seen in the preceding text, schools in Northern Ireland have recognised and addressed these challenges using digital technologies.



⇒ EdIS will provide data analytics tools to support coherent uses of data, target and manage resources, enable evidence-based approaches and support communities. Use data entered once that is then available in a range of formats to analyse trends that are automatically identified, including links to system wide data.

- ⇒ Planning tools linked in real time will facilitate modelling exercises so that various scenarios can be interrogated during the decision-making process.
- ⇒ Schools will have access to dashboards of SMS and system wide data to benchmark their practice, evaluate the impact of their work and inform their school improvement journey.
- ⇒ “Community Use of Schools” will provide an online tool to allow school facilities to be booked by community organisations/bodies, approved by school management, and paid for.

⇒ A financial management system, including financial and payroll management systems to schools in the Voluntary Grammar and Grant Maintained Integrated sectors, supports statutory and business critical school processes, reduces administration and improves data quality and flow. Detailed, accurate and up-to-date data ensures efficient delegation of delegated budgets to maximise provision of educational services.

4 Uses of digital technologies in the width of schools across Northern Ireland

Whilst most of the content of this briefing reports on outcomes of specifically focused studies that have been undertaken in a selected number of schools in Northern Ireland where digital technologies are being used, the number of schools involved can only illuminate and reflect practices that exist in a limited range of schools (whether they are nursery, primary or post-primary).

However, there are data accessible that can indicate a wider picture of uses of digital technologies through C2k across Northern Ireland's primary, post-primary and special schools and EOTAS centres. Data on school (including EOTAS centres throughout this section) usage of these forms are crucial when trying to understand potential challenges and opportunities that could respectively arise and be supported in the future.

Specific data that might be used to inform a wider picture sometimes only exist for limited periods of time before they are deleted. Given this, it is not always possible to research an archived data source to answer certain crucial and longitudinally focused policy questions. However, for the purpose of understanding how schools across Northern Ireland might be using digital technologies, recorded data for the entire month of January 2023 can offer some insights into this need. January 2023 is a period of time that presents a picture of digital technology school usage that is post-Covid-19 pandemic and is benefiting from the recent EdIS initiative which provided 21,000 devices to teachers.

Login data from inside and outside schools, from 1,012 schools across Northern Ireland, show the numbers of pupil and teacher logins on a daily basis. Using the pupil login data and adjusting for pupil numbers in each school provides an average ratio of logins per pupil. From across these 1,012 schools, the ratios in January 2023 ranged from 15.1 to 0.2. What this range tells us is that some schools were involved in practice that supported each pupil on average logging in nearly every school day (as there were 19 school days in January), to practice that supported each pupil on average logging in once every two weeks. Considering this variation, there may well be likely differences of practice across primary, post-primary and special schools. In some schools, the login may be wholly in the command of the pupil, whereas in other cases the login may be more in the command of the teacher. This range for the 1,012 schools is shown in Figure 1.

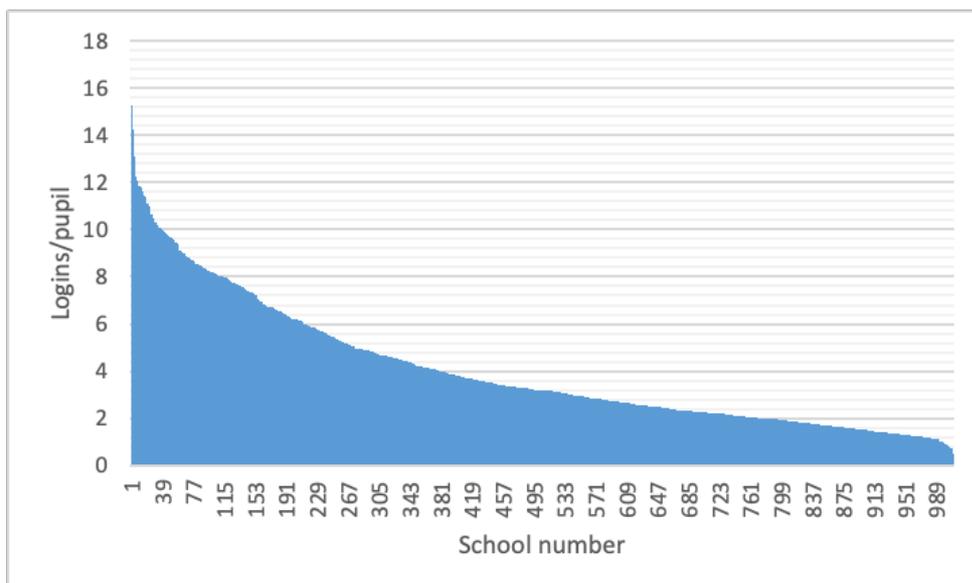


Figure 1: Logins per pupil for each of the 1,012 schools

From Figure 1, it can be seen that about half of the schools in Northern Ireland involved practice that supported each pupil on average logging in across a range from about once every day to twice a week. However, from the 54 school visits that have been undertaken where high levels of digital technology use and effective practice have been identified (mainly in schools shortlisted recently for the ICT Excellence Awards but also accommodating some recent additional research and advisory school visits), when these are plotted against the levels of logins per pupil, the 54 instances fall across a very wide school range, from school number 1 to 1,007. The logins/pupil of these 54 schools vary widely across this range, but the highest number of schools where there is known high usage and effective practice fall in the range from school number 1 to 788 (only 4 of those schools lying outside this range), as shown in Figure 2.

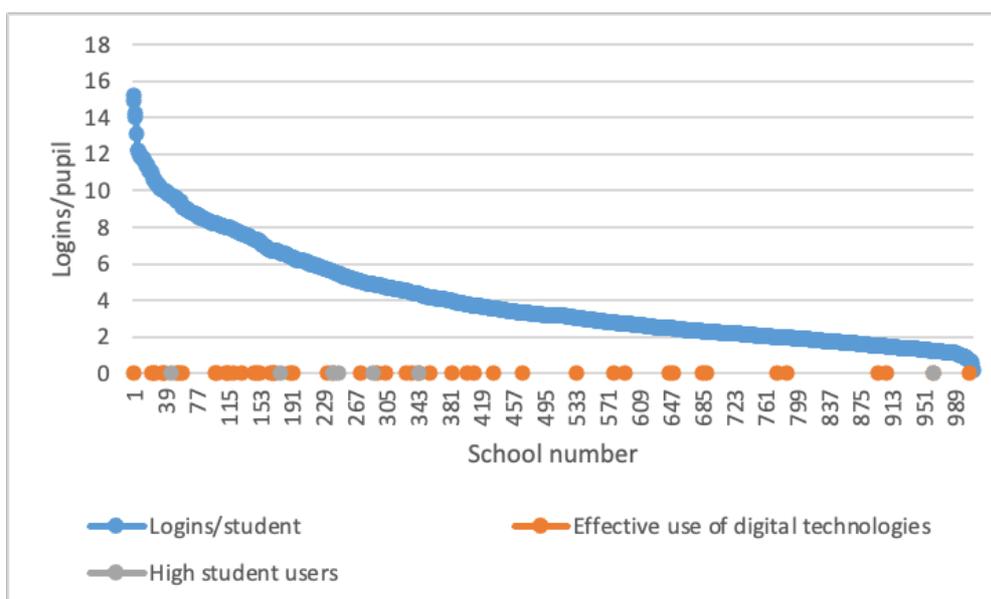


Figure 2: Effective uses and high pupil usage in schools observed compared to logins per pupil for each of the 1,012 schools

It should be noted that the majority of schools within the range of school numbers 1 to 200 are post-primary, where resources per pupil tend to be at a higher level than those in primary schools. When the practice of those schools where logins per pupil are lower than about once a week on average, whilst that practice is recognised as being effective, it is clear that those schools are often needing to share resources, sometimes across many classes or across individual pupils. In these latter cases, numbers of logins per day would be low, as the initial login for the day might be used to enable login across the entire day. Additionally, these schools are shown to find innovative ways to support their pupils in engaging with effective uses and outcomes that do not involve them in high levels of use that are seen at the other end of the range. These data indicate, from the alignment of logins per pupil against high usage and effective practice, that it is highly likely that there are many schools across Northern Ireland that use digital technologies, widely, effectively, and innovatively. The representative numbers reported in depth in this document are likely to be a small proportion of the actual number where practice is reliant upon digital technologies. This is likely to be especially so as digital practices are known to have been enhanced since the end of the Covid-19 pandemic and since the value of the new teacher devices have been recognised, driving developments of teaching, and learning forward.

While the full extent of digital technology usage in all schools across Northern Ireland is not known at this time; the breadth of usage merits specific monitoring and evaluation in the future, which may well be enabled by the uptake and use of the NAACE Self-Review Framework by all schools (see Section 5).

What is known is that instances of effective and innovative practice continue to be recognised. Future positive prospects for digital technology uptake and effective use are therefore strongly suggested. Further details about current practices would undoubtedly support uptake, would support pupil and teacher development, would support professional practice and wellbeing, and these outcomes would themselves be supported through the wide-area Northern Ireland digital network and infrastructure that is already in place, and that will be built on further through the EdIS Programme.

5. Next Steps: Promoting Continued Digital Transformation

A Literature Review produced in 2021 for the Independent Education Review Panel by Ulster University²⁴ ends (p.149) with the rhetorical question:

Can an education system fit for the 21st century be developed which incorporates technology effectively?

A clearly affirmative answer is evident, as the research evidence synthesised here demonstrates. Digital technologies can be incorporated effectively because they are already embedded by learning leaders for the benefit of learners - in at least the 43 local research papers and well over 400 school study visits reported here – not only to enhance learning, but to ensure that young people progress from schooling with the digital and associated thinking skills and personal capabilities essential for their future and that of the economy and society. These talents and skills will be especially important in the digital, ICT and creative industries identified in 10X (the NI government’s skills strategy supporting an economic vision for innovation for the next decade²⁵) for cybersecurity, software engineering, artificial intelligence, and robotics.

The ambitious 10X plan recognises the importance of access to a curriculum that provides opportunities for all learners to develop skills in the use and application of digital technology. *“Keeping pace with the rapid technological change in the global economy will require transformation in the digital capabilities of our population. The priority clusters identified in this vision where Northern Ireland can develop a unique, competitive proposition are intrinsically reliant on advanced digital skills; bolstering the supply of such skills will be key to our success. Beyond that, however, some level of digital capability is essential in almost every modern workplace and as the Covid-19 pandemic has illustrated, is increasingly linked to an individual’s capacity to participate in modern life. We need to look across the digital skills spectrum, boosting the supply of high-level skills and ensuring everyone has the capacity to participate in, and benefit from, Northern Ireland’s emerging economic prosperity.”* (A 10X Economy: Northern Ireland’s Decade of Innovation, p.28).

Whilst some schools are making significant progress in this area, a more strategic approach will ensure that schools and teachers are supported to plan and implement learning programmes that provide access to appropriate career pathways.

Beyond that, the use of online, cloud-based, digital communications has a game-changing potential to help in redesigning and reshaping the future provision of, and access to, shared programmes of study and accredited courses. Online access, between schools and across school clusters and area learning communities, enables ready sharing of expertise and knowledge-building by learners and teachers from different communities, learning, studying, and working productively together. This is particularly important in ensuring that appropriate

²⁴ <https://www.independentreviewofeducation.org.uk/files/independentreviewofeducation/2022-09/Literature%20Review%20-%20Ulster%20University.PDF> Ulster, March 2021, Challenge 5: Page 149

²⁵ <https://www.economy-ni.gov.uk/publications/skills-10x-economy-skills-strategy-northern-ireland>

curriculum pathways are available to all pupils no matter where they are geographically located.

It is notable that schools already use online technologies as a key building block in Shared Education partnerships, bringing young people from all communities together for a range of educational reasons. Their experiences provide confidence that sharing education digitally can provide the basis for joint access to online curricular programmes and accredited courses.

Promoting digital excellence

What might the Independent Education Review Panel recommend in order to promote much wider excellence in the use of digital technologies to improve learning experiences and learner outcomes? We know that excellent education, greatly enhanced by the use of digital technologies, is observed in schools where **certain critical conditions** come together.

These conditions include, for example:

- a clear vision, which embeds a digital strategy for learning within the school's overall education vision, including the needs of the wider school and home community;
- a digital vision supported by strategic and operational leadership and management; ensuring a widespread embedding in all aspects of the school's work while also enabling seamless working between home and school;
- systematic monitoring and evaluation of the quality and effectiveness of learning and teaching with technology, within and beyond the school;
- embedding of digital technologies as an integral and natural part of learning and teaching across the curriculum, enhancing, and extending learning and teaching in all year groups;
- teachers providing opportunities for creative and independent learning that extends the learners' digital capacity to learn, building their agency for learning, within and beyond the school;
- evidence showing the learners making good progress in all aspects of their digital capability in all subjects and in ways which help them to learn;
- knowledge and awareness amongst teachers and learners about how to keep themselves and others safe online even beyond school;
- practitioners, collaborating with wider school communities, to monitor and evaluate the potential impact of capabilities which make learning, teaching and organisational tasks more effective, thereby easing workload and supporting wellbeing;
- good understanding of the affordances of digital technology applications leading to their being well embedded and supportive of learning activities both in and beyond school; and
- reviewing of emerging technologies (both their opportunities and challenges) for their potential impact on practice.

Schools in Northern Ireland are at different stages in their digital technological maturity. A Self-Review Framework from NAACE²⁶, provided at no cost to all schools by the EdIS

²⁶ <https://www.naace.co.uk/si-srf.html>

Programme for the next five years, helps schools to review where they are in respect of their digital maturity, evaluate their progress, undertake action planning, and seek recognition for their progress.

The evidence summarised in this report illustrates many **specific characteristics of innovative and effective practice** which are flourishing, but which need to be promoted even more widely:

- o Learners are reliable witnesses to their own learning. When the teacher prompts talk, about their learning, by children and young people, while they are working with digital technologies, learners can be insightful – developing and displaying metacognition. For example: when coding, they see problems as something to be debugged and resolved, rather than as a sign of their failure to learn; when working with digital video and audio tools they are inspired to create, test out tentative ideas and make connections across their growing knowledge and skills; when participating in video-meets with learners from elsewhere, they come to appreciate diversity, and their ability to speak out with confidence grows. In these, and similar digital learning contexts, they know, and can explain, how their numeracy, their literacy, their problem-solving skills, and their ability work together are enhanced.
- o Learners respond well when teachers join them in ‘cyberspace’ for educational purposes. Pupils interviewed, especially during the pandemic lockdowns, expressed appreciation that teachers learnt how to increase their online presence: appearing online to teach classes, answering questions, recording explanatory videos, publishing course resources and materials which were available at all times, and providing prompt feedback on their learning. Perhaps pupils tended to think rather more of teachers as a generation alien to their own digitally-savvy peers. Now, in class, they work mutually with teachers – as digital ambassadors - supporting the use of digital technology. At the same time, teachers need to develop ways of managing expectations, their pace of work and their wellbeing.
- o The promptness of individualised feedback provided by teachers when learners undertake online activities enhances learning. Assessment for learning in the form of formative feedback may be individually confidential, presented in ways that suit the individual needs of learners, whether, for example, by digitally hand-written annotation or teacher voice-recorded commentary. When adaptive assessment becomes a continuing element of active learning, and is recorded, it steps beyond the traditional formal distinctions between formative and summative assessment. The ease of creating and analysing online surveys to reveal pupil and teacher voices about the effectiveness of teaching and learning, indeed any aspect of the life and work of a school community, provides insight and impetus for improvement.
- o The 24/7 online availability to learners of teaching assets – resources, materials, tests and so on - using the range of digital modes – text, graphics, images, animation, video – allows pupils to go over teaching points again in their own time, to undertake homework, sometimes with home support, to catch up on missed lessons and to revise out of school, for whatever reason.

- o Openness to teaching resources online promotes instances of ‘flipped learning’. Pupils read teaching materials ahead of class, as homework, and following a class quiz, the teacher is able to tailor teaching time to help the learners explore new knowledge in more depth, and appropriately, to match the levels of comprehension evident collectively and individually across the class.
- o Practices such as flipped learning allow pupils to practice self-regulation and, over time, to develop a greater sense of agency. In this way, learners are capable of taking on increased responsibility for managing their own learning. There is evidence of practice in schools having turned a corner regarding the embedding of digital learning in all classroom practice, hastened by the necessary responses to the need to support learning at home during lockdown.
- o More recently, the required and desirable elements of cross-curricular ICT (UIC²⁷) in the NI curriculum were being approached and taught in separate timetabled sessions in the week - as if it were a subject. But more recent evidence is that schools are increasingly embedding the use of desirable elements (computational thinking, coding, digital art, digital audio, digital storytelling and managing data, for example) as ways and means of learning across all of the areas and subjects of the curriculum, thereby further strengthening the agency of the learner. In this way, learning practices are stepping well beyond the sometimes-narrow interpretation of CCEA’s UIC as a set of ‘skills to be taught’.
- o Furthermore, in more effective practice, the use of the many available applications (apps) designed to teach (for example) number and language skills, are being deployed by teachers with good insight to the affordances of the software product. Now they are being deployed as part of a wider teaching plan for numeracy and literacy, with the teacher using the scores to monitor assessment, not just as a stand-alone exercise. When such products are used in isolation, they can reduce activity to the pursuit of higher and higher scores within the app itself without any learning transfer.
- o When teachers use their personal digital device through shared cloud storage – OneDrive, Google Drive or similar – it connects them to each other in their school. Such connectivity benefits them collegially through, for example: co-creation and updating of teaching and assessment resources; collection of teaching observations; assessment of pupils’ learning; much more efficient recording and reporting; an analytical approach to progress data; and sharing of their reflective practice. It may also support capacity building across school clusters and area learning communities.
- o There is a synergy to shared, collegial teacher reflection which, in the context of, for example, TCN (Trusted Colleague Network) protocols, provides for connectivity across teachers supporting efficient and effective whole school monitoring, self-evaluation, school and key-stage/subject development and action planning. Relevant documents are no longer printed off, or hand-written, and filed away. Cabinets and box files of

²⁷ <https://ceea.org.uk/key-stages-1-2/assessment-and-reporting/assessing-cross-curricular-skills/using-ict>

paperwork are of the past; teaching intelligence is accessed openly, shared readily, and combed for common evidence, indicators, and trends.

- o While there is an initial investment, which requires the planned use of teacher time and effort to prepare for teaching, assessing, record keeping and reporting online, the return on that investment is considerable. Teachers interviewed describe the productive easing of administrative workloads, say that they often feel more creative and articulate how their wellbeing is being enhanced in a positive way.
- o The importance of strong parental (and carer/guardian) partnerships is central to the effectiveness of a school serving its community well. During the pandemic lockdowns that partnership became very critical as everyone adjusted to remote teaching and home-based learning. Greatly appreciated by parents, it remains one of many so-called 'Covid-keepers'. The automation of very many administrative processes and daily information sharing between families and schools, including: the advantage of online translation tools for schools with many languages spoken in their community; the ease of conducting parental surveys to facilitate evaluative inputs to policies and practices; the facility for online teacher/parent meetings; the management of case conferences; the access by those at home to programmes of study and teaching assets; the opportunity for learners to publish and proudly share their work and achievements with those at home, are just some of the gains. Provided that there are clear protocols in place, well adhered-to by staff and parents, to manage expectations and respect and protect the safety, the working day, and the wellbeing of all concerned, the growth of an online life to school/home partnerships is a boon to education.

The aspiration of learning leadership, articulated in the Learning Leaders Strategy (DE, 2016), *“every teacher is a learning leader, accomplished in working collaboratively with all partners in the interest of children and young people”* is being enhanced and advanced by the accelerating digital transformation evident in Northern Ireland’s schools today. Collaborative online working, supported by senior leaders and school governors who lead conversations about learning, creates a digital culture for learning both within their school – and across local communities of schools.

6 The future of learning and teaching through emerging technologies

The future is unforeseeable, especially when we try to predict what might happen over long time periods, and in situations where developments are likely to occur rapidly. This is undoubtedly the case when the future of digital technologies in education is being considered. Nevertheless, this section seeks to address that future, by considering what is already known about digital technology development in fields such as emergent quantum computing, robotics, virtual reality and artificial intelligence, and by exploring briefly their implications for the future of education, teaching and learning.

In this section, key areas that we know at this time are likely to influence and have potentially significant implications for schools, for teaching, for learning and for governance, are (based on Magenheim, Morel, Osorio, Passey and Reffay, 2023):

- Computer Networks and Communication;
- Communication and Mobility;
- Cloud Computing, Privacy and Social Surveillance;
- Big Data Analysis and Machine Learning;
- AI-Methods and Algorithms for Decision-Making;
- Recognition (Tracking);
- Virtual and Augmented Reality;
- 3D/4D Printing;
- Humanoids and Digital Equity;
- Robotics and Autonomous Systems.

Computer Networks and Communication

Schools across Northern Ireland already gain enormously from the opportunities provided by the computer network that is in place. As can be seen from the examples in Section 3 and 4 of this report, principals, teachers, pupils, parents and governors increasingly rely on the presence of effective and fast computer networks, that are both safe and secure. This network provision provides the backbone for current, and importantly, any further digital technology use. As a guide to the importance of this provision, it is clear that teachers in schools now mainly complain when the network is not functioning, for whatever reason. This situation of reliance is not going to change, but network infrastructure provision will change. It is not unreasonable currently to purchase a personal mobile contract that provides 120Gb of data over a one-month period, via a 4G network (an increase from typically 12Gb of data over a one-month period from 2 years earlier). Any future capacity for schools must rely upon continually upgrading network provision to ensure communication with and between principals, teachers, pupils, parents, governors, and advisors.

Communication and Mobility

Following the use of digital technologies to support education during the Covid-19 pandemic and subsequently, we have seen shifts in ways that those digital technologies are used to support communication, and, in some instances, they are also affecting mobility. Facilities to

enable online synchronous and asynchronous communication are likely to be enhanced over the next 10 years, and to provide for functionalities such as ‘instant’ language translation (indeed Google Translate is being used already in some schools in Northern Ireland where there may be scores of languages spoken by pupils), and speech-to-text creation in forms that the user requests, such as **Caption-ed** (<https://caption-ed.com>) which generates, live, a transcript of what is being said. The recent rollout of Microsoft Surface Pro 7 devices to all teachers in Northern Ireland provides every teacher in every classroom with ‘**Present Live**’ capabilities to provide real-time multi-language translations. When teachers select the option, a personalised QR code appears on the screen. Pupils can access the presentation in their web browser by pointing their device cameras at the QR code and tapping the link. Pupils will be able to see their teacher’s spoken words transcribed in almost real-time on their screen. If a pupil requires a translation of the spoken presentation into a different language, they can select from various languages and dialects by tapping the language indicator. In a mobility context, access via online video facilities can enable geographically distant and non-mobile participation, such as enabling those in hospital to engage with other members of their school classes. In these ways, mobility can be reduced, and distance can be accommodated. Managed effectively, these functionalities could enhance inclusion and diversity, and address some of the social and economic inequalities that currently persist.

Cloud Computing, Privacy and Social Surveillance

Data storage facilities will be enhanced over the coming 15 years. Already, we see data storage that enables volumes of video as well as text to be stored. Cloud computing is supporting this requirement, but education will need to engage with two key issues: privacy (where the data are stored and by whom); and social surveillance (who can gain access to those data and how they can view and analyse them). With greater use of video and recorded video being used in schools, a key issue for the future will be to regularly monitor and assess the level of data storage facility that will be required across any time period (perhaps ideally reviewed on an annual basis), taking privacy and social surveillance fully into consideration.

Big Data Analysis and Machine Learning

We already know from school visits and research that principals and teachers are exploring ways to view data to support teaching, learning and governance. These facilities are likely to expand in the next 5 years, with companies and research units developing data analysis features and tools (probably in the form of apps in many cases) that will be focused for specific audiences. It is likely that these facilities will also become available to school governors and parents as well as to pupils and teachers. Access to educational data is already being provided to parents through some agencies and companies. What will be needed in this respect is the ability of teachers, governors, parents and pupils to be able to understand what data are being analysed, how they are being analysed, and what can be gained (and not) from the analyses that are presented. The integration of data from different sources, including between the health and education services, will also be of increasing interest; however, this is likely to raise ethical concerns that will need to be carefully considered.

Artificial Intelligence -Methods and Algorithms for Decision-Making

Some schools are already using ‘artificial intelligence’ (AI) to analyse data to support their decision-making. For example, **VEO**, developed by Newcastle University (<https://veo.co.uk/about/>) is helping professional development of teachers through self-reflection, as it allows lessons to be video-captured so that the level of teacher-talk and pupil-talk is automatically reported. Similarly, facilities that will be developed in the next five years could be of value to those involved in governance in the future, but the same forms of questions that need to be asked of big data analysis are also needed in this case: what data are being analysed, how they are being analysed, and what can be gained (and not) from the analyses that are presented. It will be fundamentally important that the end users and audiences are involved in the process of development of these facilities, to ensure not only that their needs are considered and satisfied, but also that they have a view and awareness of how the system works and operates. Involvement ‘with me’ rather than ‘for me’ is needed in this respect.

Recognition (Tracking)

Tracking systems that recognise individuals are increasingly being deployed to support a variety of educational needs and a more tailored approach to individual learning throughout the school. For example, Lexplore Analytics (<https://lexplore.com/en-gb/>) uses **artificial intelligence** and **eye tracking technology** to assess reading attainment and provides teachers with an entirely new insight into literacy development. It comes with automatically tailored recommendations of books and training material to improve reading. It provides teachers with timesaving insights into reading performance and the challenges of children individually. The application “Microsoft Reading Progress” (<https://learn.microsoft.com/en-us/training/educator-center/product-guides/reading-progress/>) is also being used in Northern Ireland schools. Learners **record their reading on camera**, and while the teacher provides feedback on their fluency, data is automatically collated and analysed into ‘Insights’, to guide teacher support. Teachers indicate that the insights facilitate them in targeting interventions based on individual needs. Special schools are also developing and using tracking systems to monitor emotions and behaviours, to support specific needs and to develop positive group engagement.

Virtual and Augmented Reality

Virtual and augmented realities are a focus of research development that is being undertaken in many different situations and contexts. Virtual reality provides a computer-generated simulation in three-dimensional form, so that the user can interact with the environment that is shown, in what appears to be a real or physical way. It requires specific digital equipment, perhaps a helmet that has a screen inside it, or gloves that have specific sensors. Such environments can provide a sense of possible future working lives for children and young people in school today, and can point to the importance of certain insights or skills that they could develop. Many examples of current VR and AR facilities are shown on the Internet, but current costs can be prohibitive, and working with VR and AR in groups rather than with individuals can be challenging. In addition to the examples referenced in an earlier section, VR and AR tend to be used in some schools to support individual needs, such as engaging with ways to consider certain behavioural issues. Researchers at the School of Education in Ulster

University are currently exploring the use of VR in teaching and learning as well as understanding its potential role in supporting pupils with Autistic Spectrum Disorder (ASD) in their transition between primary and post-primary schools at age 11 years. This research explores the barriers and opportunities of this tool in reducing transition-associated anxiety through the virtual familiarity of new places.

3D/4D Printing

Many post-primary schools in Northern Ireland and some primary schools now have 3D printers, often within technology and design (T&D) departments, and sometimes in areas called 'maker spaces' or 'maker labs'. In 2020, Northern Ireland Screen supplied 52 schools with 3D printers supported with access to training and teaching resources through the Creative Learning Centres. With these facilities, pupils can use 3D printing (especially used in vocational education contexts) to learn about CAD/CAM production methods and their possible impact on future jobs. There are examples of how 3D printing has enabled some pupils to create and innovate in developing new products as well as new businesses. Some schools are also pioneering the online development and use of 3D printing and maker spaces, to enable wider use by pupils across an area network, reducing cost and maximising use of resources. 4D printing is concerned with the facility of objects created by 3D printing to alter their shape according to the environment and context. That is, those objects change over time. For example, a 3D printed bracelet can change its shape to accommodate the temperature of the skin. Over the next 5 to 10 years, maker spaces and facilities such as 3D and 4D printing are likely to become more cost effective, as online access supports more effective cost and time distribution. There is significant curriculum potential within T&D in Northern Ireland to embrace these advanced manufacturing developments, which could position learners at the leading edge of next practice in this area.

Humanoids and Digital Equity

Humanoids such as chatbots on smartphones, often using apps, are being increasingly deployed. For education, the humanoids that might be of most interest would be those that could be said to provide online tutoring in the future, and those that can respond to verbal requests from pupils or teachers. Appendix 4 presents a response provided by ChatGPT when asked about the impact of AI on education. The response is presented coherently, assembling relevant texts from a very large language database of already published work, using key headings for the reader's consideration and demonstrates baseline awareness of some aspects associated with AI and education. However, this response is not free from bias, and that in itself presents considerable challenges for the future of work in an AI-rich world where users need to carefully interpret sources and AI-generated material carefully. Used by pupils, a main concern for education should be the potential loss of individual 'voice'; ChatGPT or any chatbot of its kind will respond through a 'voice' that is either company or institutionally generated. In consequence, ChatGPT and chatbots for education should be considered as a starting point for learning, rather than as an end point; if not, then individual concern, creativity and 'voice' are in danger of becoming lost.

Robotics and Autonomous Systems

Robots are being deployed in some schools as tools to assist the teacher, as learning companions for pupils, or as an autonomous teacher providing some level of instruction. Some robots can now ask questions, provide information, comment on answers, respond to requests, and recognise individual pupils. For example, **Aldebaran NAO Humanoid Robots** and its associated programming Software Development Kit have been used to improve communication with and engagement of pupils with a range of needs including those on the Autistic spectrum (see <https://www.aldebaran.com/en/pepper-and-nao-robots-education>). Besides any advantages of using robots in schools, there are also concerns to consider: there may be technological limitations in any AI's ability to recognise speech; there is need for pupils to avoid harm if their social interaction is minimalised; and the key abilities that teachers can provide should not be ignored or avoided.

What is outlined briefly here is potentially excitingly innovative but also challenging and unsettling.

The future with digital technologies is likely to provide a challenge to teachers and those who support them and may interfere with today's comfort zone of classroom practices.

Implications for schools will undoubtedly need to be continually monitored and investigated.

However, recent studies and reports, including those in Northern Ireland schools, demonstrate that teachers are adapting very well to the challenges and opportunities of digital technologies.

How their involvement can be maintained and how they can monitor the facilities that emerge are likely to be key to the future success of 'inspiring digital education'.

Appendix 1 The Innovation Forum.

The Education Network (NI) **Innovation Forum** is part of the Education Network (NI) C2k managed ICT service to schools. It comprises classroom practitioners and educators in education organisations supporting schools in Northern Ireland and is an important element of the Education Authority's C2k Digital Strategy for Learning. Independently chaired by Professor John Anderson, the Forum promotes, through research, evaluation and information sharing, a culture of innovation in the creative roles of digital technology in schools. It contributes to benefits realisation/return on investment in the use of C2k digital services and responds to the need for the managed service to continue to evolve through the development and implementation of the Education Authority's Education Information Solutions (EdIS) Programme to meet changing education needs.

The Forum acts as a reference group, providing judges for the Capita/C2k Northern Ireland Schools ICT Excellence Awards which were established in 2015. The entrants for the awards, the highly commended schools and the Award winners exemplify the highest standards in the creative and effective uses of digital technology in classrooms in Northern Ireland.

Since 2015, the Forum has been engaged in a range of evaluation and research initiatives which test, investigate, and explore innovative uses of technology in schools (primary, special, and post-primary) and EOTAS centres in Northern Ireland.

Professor Don Passey of Lancaster University has been research advisor to the Forum since it was established and, along with the other main authors and advisors for this briefing report, all of whom are members of the Forum, were ably supported by Dr Allison Campbell as research assistant for this report.

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Appendix 4

Response from ChatGPT when asked to consider the impact of AI on education

The integration of artificial intelligence (AI) into the education sector is a rapidly growing trend, with the potential to significantly impact the way in which education is delivered (Brown et al., 2020). One AI technology that has received considerable attention recently is ChatGPT, a large language model developed by OpenAI (Brown et al., 2020). This article examines the implications of ChatGPT for education systems globally, focusing on its potential impact on the teaching workforce, learners, and the education system as a whole.

Impact on the Teaching Workforce:

The integration of ChatGPT into the education system has the potential to significantly reduce the workload of teachers (Barker, 2022). By automating routine tasks such as answering frequently asked questions or providing additional information on a subject, teachers can focus on more important tasks such as lesson planning and one-on-one interactions with students (Gans et al., 2019). This can lead to an increase in job satisfaction and overall teacher well-being (Wei & Chen, 2020). A study by Lu and colleagues (2020) supports the notion that AI can assist teachers in their daily tasks and improve their overall job satisfaction.

Impact on Learners:

The use of ChatGPT in the education system has the potential to significantly improve the learning experience for students (Barker, 2022). It can provide personalized and interactive learning experiences that promote student engagement and motivation (Foster & Gee, 2019). Additionally, ChatGPT can enhance language learning, providing real-time responses to students' questions and improving their speaking and writing skills (Brown et al., 2020). Furthermore, it can provide additional support for students with learning disabilities by providing step-by-step instructions and additional explanations for difficult concepts (Gans et al., 2019). A study by Hong and colleagues (2021) showed that students who used AI-powered learning systems had higher levels of engagement and achievement compared to those who did not use these systems.

Integration into the Education System:

The effective integration of ChatGPT into the education system will require careful consideration of various factors, including the quality of the data and training it has received, as well as the specific ways in which it will be used (Barker, 2022). One potential approach could be to use ChatGPT as a supplement to traditional teaching methods, rather than as a replacement for human teachers (Foster & Gee, 2019). For example, it could be integrated into existing technology infrastructure, such as learning management systems, to provide additional support for students and teachers (Wei & Chen, 2020). A study by Thompson and colleagues (2022) found that the use of AI-powered tutors in conjunction with human teachers resulted in improved student outcomes and higher levels of student engagement.

Conclusion:

In conclusion, the integration of ChatGPT into the education system has the potential to significantly improve the learning experience for students and reduce the workload of teachers. However, its effectiveness will depend on the quality of the data and training it has received, as well as the specific ways in which it is integrated into the education system (Barker, 2022). Further research is needed to fully understand the implications of this technology for the education system in Northern Ireland and globally, and to determine the best approaches for its implementation (Gans et al., 2019).

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