

# **Trends and Issues of Digital Learning in the United Kingdom**

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## Abstract

This chapter reviews the current state of digital K-12 in the United Kingdom with emphasis on England. It gives evidence to substantiate the UK's high ranking in digital maturity studies and analyses. The chapter begins by summarising England's K-12 system and the factors of the National Curriculum and National Exams which produce a uniform system despite the wide variety in size, purpose, organisation and funding of schools. It describes the digital policy interventions, funding schemes, large-scale projects and influential reports in the period 2010-23, demonstrating that decisions taken more than ten years ago have continuing effects today, and that the pandemic rapidly accelerated existing trends rather than setting a brand new direction. A broad view is taken of infrastructure covering technology, leadership, budgets, course design/delivery, ensuring student success, staff development, quality/inspection, and analytics. It provides data, with key examples, supporting the main trends analysed - bandwidth, school networks, software, end-user devices, and content. It covers topics often omitted in such reports, such as private schools, homeschooling, virtual schools, open content, online national examinations and the overlap of K-12 with the post-secondary sector. It reviews key issues: structural disorganisation leading to fragmented procurement of a plethora of systems, the multi-dimensional isolation of K-12 including the disconnect between school and post-secondary digital approaches and systems, lack of clarity on the role of parents, the rigidity of the school day/week/year limiting the scope for blended digital learning, and the promise but problems of advanced technologies.

**Keywords:** digital schools, virtual schools, online schools, primary school, secondary school

# Introduction

## The structure of the K-12 system in the UK

The UK does not have one single UK-wide model for its school system. Despite being part of the UK, Scotland retains its own education system with four years to study for a bachelor degree - the three other home nations have 3-year bachelor degrees but one more year in schools. The description that follows is based on England (over 85% of the UK population). The UK government's *Department for Education* has jurisdiction only over education in England.

K-12 provision comprises state schools and private schools. Private schools receive no state subsidy - they educate around 7% of students, rising to around 18% for students at Sixth Form (Green, 2022). There are two main types of state school: municipality-based schools, but now also semi-autonomous directly-funded schools with "more freedom to change how they run things" (Department for Education, n.d.) – with Academies and Free Schools as sub-types. Municipalities are called "local authorities" in England - over 150 of them (Wikipedia, 2023a).

No UK teacher uses the term "*K-12*" - instead the term *school sector* is used. There are 13 grades - *years* - at school. Years 12 and 13 are *Sixth Form* - in these students study A levels or level 3 vocational qualifications. Students at school are called *pupils*. The *age of majority* when children become adults is 18, but from 16 children gain some rights, and are then called *young people*. Typically schools are divided into *primary schools* (children age 5-11) and *secondary schools* (age 12-16 or 12-18). A few municipalities still have *middle schools*, ages 9-13 (see Figure 1 and Table 1).

Private schools are called *independent schools* in government documents, but

"public schools" in general conversation - which is very confusing outside the UK (Good Schools Guide, 2023). The word *college* usually means a state-funded post-secondary non-higher education institution, a *further education college* (FE college). Confusingly, several colleges teach school-age pupils, mostly in Sixth Form Colleges or departments. Even more confusingly, some Sixth Form Colleges are changing to Academies, a type of state school (Department for Education, 2023c).

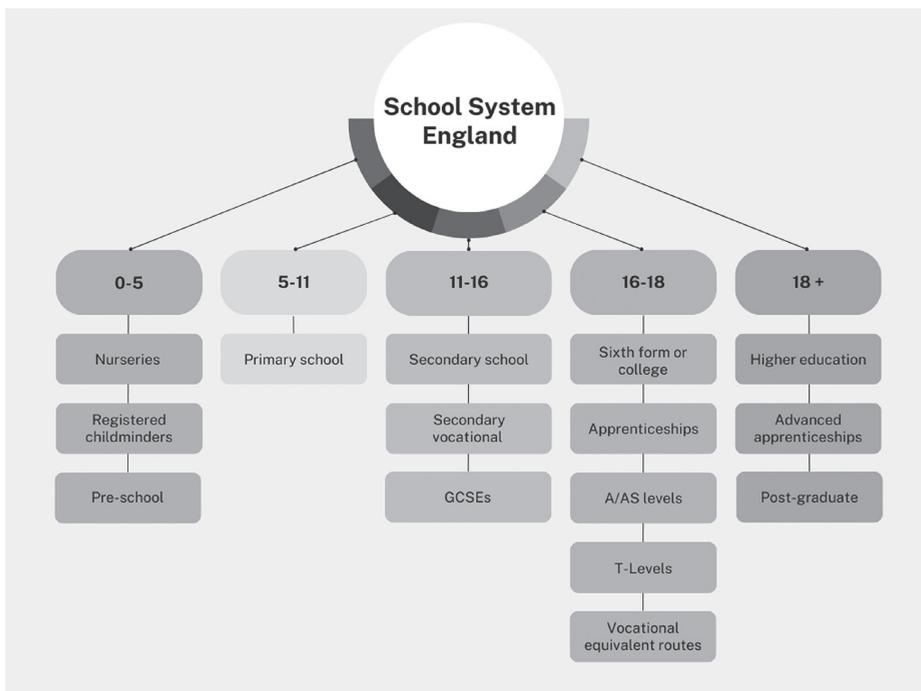
The National Curriculum is a complex set of guidance documents (Department for Education, 2014) on what to teach at each stage of the compulsory school system (Enser, 2020). There has been little serious attempt in England (until Covid) to "put the curriculum online".

National Examinations specify how all this is assessed, both at the end of the compulsory school system and at the end of the Sixth Form. The *General Certificate of Secondary Education* (GCSE) is the exam that most students take at 15-16. Students are encouraged to take at least five GCSE subjects including those in the *EBacc* (English Baccalaureate) (Department for Education, 2019b). Students can leave school at 16, but if so they must enter another educational institution or get an apprenticeship or trainee post (The Education Hub, 2023). Normally two years after GCSEs, students wishing to enter higher education or higher-level employment sit A levels, available in over 80 subjects. Typically students take three or four (McLennan, 2022). Many A level subjects can be studied fully online, though rarely by students in state-funded schools.

There is a parallel strand of vocational qualifications that many students study - including BTEC (UCAS, 2023). In 2020 the government introduced T levels, "broadly equivalent in size to 3 A Levels" (Department for Education, 2023h). In 2023 the government announced that work will start on a new *Advanced British Standard* to subsume A levels and T levels into a broader qualification, more consistent with Scotland and many other countries (Prime Minister's

Office, 2023) - however, the proposals will take years to implement and have already generated much criticism even from supporters of the government (Spectator, 2023).

**Figure 1** Structure of the School System in the United Kingdom/England



**Table 1** Schools in England - Summary Data

Number of schools	24,442
Pupils in schools	9,073,832
Teachers in schools	468,371
Average class size	26.7

Note. Education Statistics, 2023b.

## Overview of digital transformation in schools

Most UK schools are at the end of Stage II substage Digitalization - noting that this stage never finishes as systems are updated. The UK scored 86.45 overall in the IMD *World Competitiveness Digital Ranking 2022 Report*, with its ranking rising from 10 in 2018 to 16 in 2022 (IMD, 2022).

The Department for Education commissioned a report on digital maturity in 2022, based on UK surveys and methodologies, concluding that "around 9% of the schools surveyed were high in maturity, 31% were low and 60% moderate" (CooperGibson Research, 2022).

There have been many digital policy interventions in education in England, from the 1990s through to around 2011. The government agency Becta was key to these but was closed in 2011 as part of recession-induced cuts (Gov. uk, 2011). This led to many years of minimally visible *policy*, but continued investment and development in practice.

Digital K-12 provision remains incomplete in terms of digitization beyond Stage II substage Digitalization: however there are many examples of good practice.

## The Status of Digital Learning

### Contexts of digital learning: policies, strategies, programs, projects, research

This policy area is called "ICT for education" in UK papers. There is a long history of policy development (TPEA, 2023) from 1967 with the formation of the UK *Council for Education Technology* - later the *National Council for*

*Education Technology* and finally Becta. A history of "30 years of technology in education" (Rossi, 2015) notes that Becta was a "landmark", set up in 1998 with a *UK-wide remit for all education*, not just K-12 in England. The ambitious scope of Becta is clear from two reports for the Becta project *CAPITAL*: (Bacsich & Pepler, 2008) on ICT-induced change in *all* education sectors, and (Bacsich, Harrop, & Lackovic, 2010) on international issues.

### ***Policies and strategies***

There were just *two* main policy announcements *before* those of the Covid era 2020-22 - *Harnessing Technology* in 2005 and *Realising the Potential* nearly 15 years later (2019), punctuated by the unexpected closure of Becta in 2010 (see Table 2).

The 2019 policy was planned to set the tone and funding envelope for subsequent years of activity. However, higher-level political challenges meant that there was little government, public or teacher attention paid to education technology matters until the Covid lockdown started. Nevertheless, this policy facilitated the funding schemes for Covid responses. The main commitments were: full-fibre internet connectivity to schools, cloud services, demonstrator schools and online training courses for teachers/leaders (Department for Education, 2019d).

**Table 2** Summary of Policies and Strategies

Date	Policy	Reference	Description
2005	Harnessing Technology: Transforming Learning	(Department for Education, 2005)	"the ... first cross-sector e-learning strategy. ... what the technology can do for ... transforming the experience of learning."
2010	Government closes Becta	(Department for Education, 2012)	"schools are now in a position to manage much of this themselves."
2019	Realising the potential of technology in education	(Department for Education, 2019d)	"... to do more to explore and reap the benefits that technology can bring. ...the first step..."

## *National programmes*

In addition to the policies there were three main programmes - *National Grid for Learning* (1998), *Laptops for Teachers* (2002-05) and *Building Schools for the Future* (2003-10). The last was not a specific ICT programme but had a substantial ICT strand within it (see Table 3).

**Table 3** Relevant ICT-Related Programmes

Date	Policy	Reference	Description
1998	National Grid for Learning	(Selwood et al., 2001)	"a gateway ... a curated collection of links to resources and materials of high quality ... to support schools ...." (Wikipedia, 2023b)
2002-05	Laptops for Teachers	(Royal Borough of Kensington and Chelsea, 2004)	"announced ... January 2002. An extension of the initiative from two to four years and an increase in funding was announced ... January 2003."
2003-10	Building Schools for the Future	National Audit Office	"to renew all 3,500 English secondary schools over the 15-year period 2005-2020, ... to entirely rebuild half the school estate, structurally remodel 35 per cent, and refurbish the rest. Refurbishment includes <i>providing new ICT to recently built schools.</i> " (National Audit Office, 2009, p. 7)

## *Commissioned reports*

Despite the lack of actual policy announcements there was a constant stream of funded reports on various aspects of digital K-12 - the six most important are tabulated in Table 4.

**Table 4** Research Reports

Date	Policy	Reference	Description
2010	Shaping contexts to realise the potential of technologies to support learning	(Manches et al., 2010)	"The final report on the CAPITAL project (Curriculum and Pedagogy in Technology Assisted Learning."
2012	The Impact of Digital Technology on Learning	(Higgins et al., 2012)	"Recommended strategies towards the improvement of effective use of technology in the classroom."
2015	Education Technology Action Group: Our reflections	(ETAG, 2015)	Explored how educational technology could be harnessed to transform teaching and learning experiences, including barriers and opportunities.
2022	Education technology for remote teaching	(Department for Education, 2022d)	A review of UK evidence on remote teaching, including case studies highlighting what worked well.
2022	Future opportunities for education technology in England	(Vicentini et al., 2022)	"Aimed to provide insights to the future of the EdTech market in England, considering likely developments in digital technology and education policy."
2023	Innovating Pedagogy 2023	(Open University and UCT, 2023)	This annual report highlights emerging trends and technologies in education.

### ***Digital learning implementation***

All levels and types of schools have some level of digital education. A key report showed that "64% of schools in the UK are ... embedding technology" (EdTech Assessment Tool, 2022). Secondary schools use free tools like G-Suite for Education or Microsoft Teams to communicate with learners, set tasks and provide resources. Most primary schools have digital use too - for example, Shireland Technology Primary School has classrooms equipped with

"interactive smart boards, to laptops and iPads, to audio-visual recording technology, to programming and robotics kits" (Shireland Technology Primary, 2023).

In 2018 a key report claimed that shortage of STEM skills was costing £1.5billion (Ledgerton, 2018) - work to alleviate this was enabled by the *UK Science and Technology Framework* with 10 key actions to achieve "becoming the most innovative economy in the world" by 2030 (Government of the UK, 2023). *STEM Learning* champions education in this area, providing resources, training and partnerships to primary, secondary and post-16 teachers and learners (STEM Learning, 2023).

The *National Centre for Computing Education* (NCCE) states that "54% of students studying AS and A level have engaged with Isaac Computer Science" (NCCE, 2022). Isaac is a free online platform. *Barefoot Computing* was set up in 2014 with resources to prepare primary school teachers for the changing computing curriculum, "reaching 3 million pupils and over 85,000 teachers in the majority of primary schools across the UK" (Barefoot Computing, 2023). The *Code Club* has 8,500 Code Clubs in schools (Code Club, 2023).

### ***COVID-19 digital learning acceleration***

The pandemic provided an urgent need for schools to accelerate their digital transformation, implementing systems or work-arounds to provide their students with learning available online. In primary schools, school websites were often utilized to create a dedicated area where year groups could access and download relevant work or links to signposted topic videos. Secondary schools generally, in time, provided course work and homework with feedback via Zoom, Google Classroom or Microsoft Teams - few had done that before.

Early in the pandemic there was very little *action* from government for a rapid move to remote digital K-12, with a few key exceptions, such as authorising

funds for purchase of devices. However, in a way typical of the UK, a combination of government agencies, the BBC, large IT vendors, charities, schools, teachers and parents rapidly achieved useful results - with context a series of policy recommendations from the Department for Education 2021-2022.

Within two weeks of the first lockdown the BBC announced a major extension of its pre-existing educational offerings both via TV and online to start at the beginning of the summer term in England and the three other home nations. The service focused on *BBC Bitesize Daily* (BBC, 2020).

Vendors such as Microsoft, Google, Zoom and others ramped up their cloud-based offerings and provided free services to schools. Deployment of Google Classroom or Microsoft Teams was supported by the *Get Help with Technology* programme (Department for Education, 2020).

The leading commercial vendors of VLEs - Instructure, D2L and Anthology - all provided substantial free support and advice to their education clients during Covid. This was of great value to UK *universities and colleges*, but in the UK few schools use such systems. One school running Brightspace produced a case study on its experience during Covid which for them was far less problematic than for most schools (Deans, 2023). Moodle reopened their *Moodle Basics for Teachers* course in March 2020 and their forums were an active supportive environment (Moodle, 2020).

The Oak National Academy was the main content action that the government took. It was created in April 2020 with funding from the Department of Education. It has now "developed 40,000+ resources with the support of 550 teachers and delivered over 150 million lessons in [the] online Classroom" (Oak National Academy, 2023a).

In contrast, in Scotland, there *had already been* a well-developed service SCHOLAR offering online content and courses covering the Scottish sec-

ondary school curriculum up to all the usual exit points (SCHOLAR, 2023). During the pandemic Scotland developed this further, into the *National E-Learning Offer* (2022).

## ***Funding***

The government ensured that substantial funds were released to provide devices and networks to support remote learning, via the *Get Help with Technology and High Speed Internet* initiatives (see Table 5).

**Table 5** Funding Schemes to Support Remote Learning

Date	Funding scheme	Reference	Brief description
2020-22	Get Help with Technology: £374m	(Department for Education, 2020)	This provided devices and mobile data, with "over £160 million to support remote education. ... 220,000 laptops and tablets for disadvantaged children" (FE News, 2020).
2022	High Speed Internet: £150m	(Department for Education, 2022a)	To help schools in Education Investment Areas upgrade their networks.

## ***Digital learning challenges during the pandemic***

There were six key challenges faced by teachers as below:

1. The **rapid shift to online learning** presented an urgent requirement to find ways to transition to remote learning when most teachers had no skills in the area. The plethora of systems used in schools made effective rapid mass training impossible - educators were using over 50 different platforms (Gibbons, 2020).
2. **Digital divide** surveys demonstrated the lack of access thousands of pupils had to a suitable device or the Internet: "7% did not have fixed broadband and

4% had access only via a mobile phone" (Ofcom, 2021, p. 4).

**3. The challenges of adapting delivery for different needs.** Teachers had to cope also with face-to-face teaching and delivery of learning packs to some students.

**4. Digital literacy: students, teachers and parents.** Digital literacy acceleration was promoted through use of online tools. Vendors, associations and schools provided webinars and guidance in how to use tools and systems where appropriate.

**5. Online security and safeguarding** presented challenges in relation to reliance on digital platforms and the online safety aspects (Department for Education, 2021).

**6. Mental health and well-being** were key issues for young people who were suddenly without their usual daily term-time routine and support structure. A mental health and wellbeing survey was updated throughout the pandemic - the final report noted that "symptoms of depression and post-traumatic stress disorder (PTSD) ... significantly increased in children and young people" (Office for Health Improvement and Disparities, 2022).

## **Digital learning infrastructure**

### ***Technology infrastructure***

In general terms, each school in England has a good technology infrastructure:

1. Most schools have a high-bandwidth connection to the internet.
2. All schools have a local area network with wired and wireless provision.
3. Most schools have a selection of devices to access the network - desktop and laptop devices with keyboards but also tablets with touch screens - although the user:device ratio is rarely even close to 1:1 for student devices.

4. Almost all schools use electronic whiteboards for audio-visual equipment (data projectors are much less common).
5. End-user software has a focus on content development and editing - for textual documents Microsoft Word on many devices, and Google Docs for Chromebook or tablets.
6. Servers (for file storage, etc) are gradually moving to the Cloud.
7. Schools have a collection of tools to handle resource-based learning, collaboration, and assessment. They also have tools to supply online content. However, schools normally deliver such functions via separate tools and apps - only a few run a university/college-standard VLE.

Schools in Scotland, Wales and Northern Ireland benefit from a more centralised approach to provision and centralised services. These models are relevant exemplars for English regions:

- Scotland had *Glow* - a "digital environment to support learning across the whole curriculum" to schools "including independent schools and teacher education colleges/universities" (Glow, 2023). Many schools have internet connections and services supplied by the *Scottish Wide Area Network* (SWAN, 2023).
- Wales had *Hwb* - "to support teaching and learning activities" but only for "maintained schools" (Hwb, 2023).
- Northern Ireland had *C2K* - which "provides a core ICT service to all grant-aided schools ... hardware, software, connectivity and technical support" (Department for Education NI, 2023).

In contrast, in England, provision of funding and support for this is decentralised, with different types of solution in different parts of England and for different types of school.

England is unlike many countries of similar population size in that it has no standard subdivision into regions with stable boundaries. There used to be a

structure of nine government office regions in England - from 1994 these had some devolved functions and were the constituencies for elections to the European Parliament and reports to the EU. In the 2000-2009 decade they were used for the ten Regional Broadband Consortia in England and for procurement purposes - a few of these survived into the National Education Network (NEN, 2023), but most were dissolved in the mid-2010s (Rotherham Borough Council, 2014).

In 2010 the devolved powers were abolished and regions' political relevance ceased when the UK left the EU in 2020. Instead there is a complex and ever-changing set of groupings - counties, districts, unitary authorities, city mayors - aiming to support schools and provide school services. In addition, many schools are Academies, autonomous from their municipality. This makes it hard for education ministers to get policy implemented - in the inimitable words attributed to a former Prime Minister, "you pull the lever, and nothing happens" (Stewart, 2014).

The creation of *Academies* (Gove, 2010) and grouping them into Multi-Academy Trusts (Department for Education, 2016) introduced an alternative non-geographic devolved structure. The Department for Education did set up a regional structure to try to cope with this which did not align with Government Office Regions. However, in a wise move, the government announced in 2022 that they would be "aligned to the 9 regions used elsewhere in government" (Department for Education, 2022b).

The data that follows is mainly taken from the *EdTech Survey 2020-21* (CooperGibsonResearch, 2021).

### *1. School connection to the internet*

Many schools do not yet have access to high-speed internet (a 1 Gbps connection or more). "Primary schools (49%) ... were significantly more likely

to experience lower bandwidth ... compared to secondary schools (21%)" (CooperGibsonResearch, 2021, p. 16). This was no doubt one reason why the government announced a plan in 2022 for all schools "to have high speed internet by 2025" (Department for Education, 2022a). The announcement contained specifications to guide schools in provision, with clauses on full fibre, a backup link and IT security (Department for Education, 2022f). These specifications are part of a set (Department of Education, 2023k) which also cover colleges.

## *2. On-premises networking (wired and wireless)*

All schools have a local area network with wired and wireless provision. However, in 2018 "Only 78% of primary schools and 81% of secondary schools believe they are well resourced with Wi-Fi" (BESA, 2018). In 2019 the *Realising the potential* policy document admitted that "schools, colleges and universities can struggle with the interruption to teaching and the wasted time ... that accompany poorly implemented local networking and Wi-Fi." (Department for Education, 2019d, p. 13).

However, in 2021 the EdTech survey reassuringly claimed some progress: "Wireless and broadband connectivity in school [are] 'small' barriers rather than 'big' barriers" (CooperGibsonResearch, 2021, p. 97). By 2022 government policy was clear: *use the Wi-Fi 6 standard*, with detailed recommendations (Department of Education, 2023k).

## *3. End-user hardware (students and staff)*

CooperGibsonResearch (2021, pp. 17-18) provides detailed data on hardware:

*Primary schools were more likely to use tablet devices (teachers and pupils), whereas secondary schools were more likely to use laptops and desktop computers.*

*... 1:1 access to mobile devices for pupils was extremely low. Just 1% of primary schools and 2% of secondary schools provided access to at least one mobile device (tablet or laptop) for every pupil.*

*Amongst primary schools, 15% had access to one mobile device for every two pupils and 21% for every three pupils. Three-fifths of primary schools (61%) had access to one mobile device for every four pupils or less (ratio of 1:4 or lower).*

*Pupil access to mobile devices amongst secondary schools was much lower. Just 3% had access to one mobile device for every two pupils and 9% for every three pupils. Eighty-four percent of secondary schools had access to one mobile device for every four pupils or less (ratio of 1:4 or lower).*

*Device ratios for desktop computers were higher amongst secondary schools, with two-fifths having a device ratio of 1:5 or more (compared to 2% for primary schools)*

The Department for Education seems cautious about its approach to supply of what it calls "appropriate devices" (laptops, tablets, etc) to students. There is no scheme to ensure that every child has an appropriate device, indeed there is no statement that an appropriate device is even required, On the other hand it accepts that these devices are useful for learning and assumes that students will somehow gain access. There are schemes to ensure that many "disadvantaged" children have such devices supplied, but with complicated rules.

By the end of the pandemic, 1.96 million appropriate devices were delivered and over 100,000 routers (Department for Education, 2022e).

#### *4. Audio-visual equipment*

"The vast majority of schools had interactive whiteboards or blackboards: primary 97%, secondary 91%" (CooperGibsonResearch, 2021, p. 17).

#### *5. End-user software (students and staff)*

End-user software is usually Microsoft Office and/or Google Docs.

#### *6. On-premises servers and off-premises servers including Cloud*

Servers (for file storage, etc) are often still located in-school but are gradually moving to centralised services and the Cloud (CooperGibsonResearch, 2021, p. 16).

#### *7. Central applications*

Schools have tools to supply online content to students - from publishers like Pearson (2023b) and TES (2023) or new-generation providers such as Khan Academy (2023). A popular UK-specific tool is GCSEPod, claimed to be "for learning or revising for your GCSE/IGCSE exams" (GCSEPod, 2023).

One key bit of information is that 70-80% of UK schools used the management information system SIMS (Kunert, 2021). This shows that some uniformity is feasible.

### ***Leadership and budgets***

Leadership development for head teachers and senior teachers is well developed, with *National Professional Qualifications* (NPQs) delivered via courses, normally free to study, supplied by "approved providers" (universities, charities, churches, etc.) (Department for Education, 2023i).

In terms of funding and budgets, the funding formula for a state-funded school

in England is set by government (Department for Education, 2022g). The formula is complicated - in summary (Department for Education, 2023j), "average per-pupil funding in schools for 2023-24 is £7,460". This does not all go to schools: *spending by schools themselves* (excluding spending at Sixth Form Colleges) was £5,974 per pupil in 2022-23 (Institute for Fiscal Studies, 2023).

State spending per pupil is around 2/3 of the undergraduate tuition fee (cap) of £9,250 in higher education (Office for Students, 2023). Since university staff are paid more on average than teachers and many do research as well as teaching, it may seem surprising that schools cannot afford the integration and sophistication of ICT solutions, in particular VLEs, that universities have. It is even more surprising given that some higher education providers charge fees closer to £6,000 than £9,250, and yet still afford such tools. Admittedly, universities have ways of earning more than £9,250, from non-UK students and post-graduate programmes, as well as entrepreneurial activity.

One budgetary nuance for schools is the pupil premium, "to improve educational outcomes for disadvantaged pupils", currently £2.9 billion (Department for Education, 2023d). This can be up to £2,500 per pupil, but more usually £1,000.

### ***Course design and delivery***

The need for a design approach is understood by teachers, and there are many guidance documents (Ferrell et al., 2018). There are several methodologies which learning designers can use (University of Bath, 2023) - the most widely used is *ABC*, from University College London (*ABC Learning Design*, 2023). However, there is no evidence that *ABC* and similar approaches are used in schools. Teachers are more familiar with "lesson design", usually called "lesson planning", but see less need to regard a group of lessons as a coherent learning design. There could be several reasons for this, including that course syllabi are more under teacher control in post-secondary education, due to the

lack of a national curriculum.

Delivery of lessons via the whiteboard, "present in over 90% of classrooms in Britain" (Twinkl, 2023) is a dominant pedagogic approach.

Another obvious pedagogic approach is homework. There is no statutory overall requirement for students to have to study at home. Instead, such matters are left to each school - the government keeps no records of how much homework is done. However other agencies carry out surveys - one stated that on average UK children do 4.9 hours per week, with more in sixth form and much less in primary school (The School Run, 2023). In theory this homework time could be used for home pre-reading, allowing "flipped classroom" activities during the school day; in reality, homework usually involves some task whose output is graded or discussed in class the next day.

### ***Student success for digital learning***

Student success for digital learning depends on many factors. The critical ones are already in the list of topics in this section. The main schools-focused EU schemes covering such aspects, DigCompEdu and SELFIE for Teachers (European Commission, 2023b), did not gain traction in the UK even before the UK voted to leave the EU - they are sometimes used in UK-specific work (ETF, 2018), though for colleges not schools.

Specific schools provide many examples of success-oriented approaches.

- The *Remote learning policy* at Holmer Church of England Academy sets out minimum provision of academic support, "3 hours a day on average across the cohort for Key Stage (KS) 1, with less for younger children and 4 hours a day for KS2" with completed work to be uploaded to Seesaw (an interactive learning platform for K-5) and learning via Microsoft Teams for both mathematics and literacy (Holmer C of E Academy, 2023).
- In Wales, Broughton Primary School's *Digital Policy 2021-2022* describes

the type of support provided by schools to learners with additional needs: "The school currently provides identified learners with a 1-1 iPad with accessibility features such as Office Lens, Immersive Reader and dictate to create a more inclusive learning experience" (Broughton Primary School, 2021).

School libraries can play a key role in supporting digital learning for students. CILIP (the Library and Information Association) claims that "Digital literacy starts in the school Library" (Hutchinson, 2021). There is no national strategy for school libraries but many municipalities do have a library strategy covering schools (Leeds for Learning, 2023).

### ***Evaluation and analytics***

Ofsted, the *Office for Standards in Education, Children's Services and Skills*, oversees the quality of all state-funded schools. It has similar powers over "childcare, local authorities, adoption and fostering agencies, initial teacher training and teacher development" (Ofsted, 2023).

Private schools have a separate inspection system, the *Independent Schools Inspectorate*, authorised by the Department for Education (ISI, 2023) under the *Education and Skills Act 2008* Clause 106 (UK legislation, 2008).

Learning Analytics is the "measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs" (SOLAR, 2023). However, it has come to have a narrower meaning, the use of specific IT systems, using sophisticated mathematical methods to generate insights not obvious from the data.

The EdTech Survey report suggests that "learner analytics" was the fourth most used technology, after whiteboards, computers/tablets and assistive technology (CooperGibsonResearch, 2021, p. 18). The headteachers' survey in the

same report claims (in Table 19) that learner analytics is used in 26% of primary schools and 51% of secondary schools (CooperGibsonResearch, 2021, p. 73). In the view of the authors this is implausible except in the widest possible sense of analytics, that is, covering much of what good teachers do routinely.

A search of Google Scholar yields no papers since 2019 about schools in the UK with titles containing the phrase "learning analytics" (or "learner analytics").

### ***Teacher and staff professional development***

In 2019 the government's *Realising the potential* strategy stated: "with the Chartered College of Teaching we have launched online training courses for teachers and leaders in education, which strive to improve the use of technology in teaching" (Department for Education, 2019c, p. 16). The first was the FutureLearn course *Using Technology in Evidence-Based Teaching and Learning*, still running (FutureLearn, 2023). In 2023, however:

- The Chartered College does not list any other EdTech courses on its web site (Chartered College of Teaching, 2023).
- The government site *Professional development for teachers and leaders* (Department for Education, 2023i) does not offer any EdTech or ICT courses.
- The FutureLearn course offers just 12 hours of study.

FutureLearn now offers a range of over 20 short courses (at a fee) covering many aspects of digital learning, with in addition some microcredentials and degree-level qualifications (FutureLearn, 2023). However, these longer courses are priced at "market rates" typical of UK university courses, with no evidence of any subsidies for teachers.

There are now many other offerings available to teach teachers to teach in a digital context, although many of them are oriented to teachers in colleges.

One qualification is paradigmatic - *Teaching Teachers to Teach Online*, developed in 2018 to train teachers at virtual schools. Key features were (Online Educa Berlin, 2020):

- **12 credits of study** (a typical amount of study for a university module), not the 2 credits typical of most introductory courses.
- **Taught both pedagogy and practical skills** for digital content development, teaching and assessment.
- **Assessed** via both project-based assignments and a portfolio compatible with CMALT (Association for Learning Technology, 2023a).
- **Accredited** within the England framework for vocational qualifications (Ofqual, 2019) - a "microcredential" (King, 2023).
- **Delivered** via Canvas, one of the four standard VLEs used in UK universities and colleges.

## Features of digital learning

There are three features of digital K-12 in England which are not found in many other countries.

### *1. Homeschooling*

In England, *students do not have to attend a face-to-face school*. Parents can "homeschool" their children, in other words, teach them at home with help from online resources or online tutors. This means that there is a market for online content and service provision *direct to parents* in a way different from many other countries.

Officially, homeschooling is called *Elective Home Education* (EHE). The *Education Act 1996* Article 7 states: "The parent of every child of compulsory school age shall cause him to receive efficient full-time education... either by regular attendance at school *or otherwise*." (Department for Education, 1996). This Act confirms a long UK tradition of both home-schooling and virtual at-

tendance at a range of virtual schools - which is officially regarded as home-schooling.

There is no official register of children in homeschooling. There are also no specific legal requirements for the content of home education, "provided the parents are meeting their duty in s.7 of the Education Act 1996" (Department for Education, 2019a, p. 8). Parents are not required to notify any authority if they homeschool their children. In fact, "If a child never attends school, an authority may be unaware that he or she is being home educated" (Department for Education, 2019a, p. 12). Government estimates indicate "86,200 children in elective home education in Spring term 2023" (Education Statistics, 2023a). However, this number may not reflect the true scale of homeschooling.

## ***2. Too wide a range of systems and devices***

This brings together points made elsewhere in the chapter.

Teachers in England use over 50 different ICT systems (Gibbons, 2020). Very few schools run one of the four global VLEs used in universities and colleges (Moodle, Canvas, Brightspace or Blackboard) - instead they use less functional offerings, which no post-secondary UK institution would use in a core role for online teaching and learning.

The demands of employers of professionals require a post-secondary institution to ensure that students are competent in Microsoft Office. The vast majority deploy and/or require students to have Windows PCs (a few use Mac computers). In contrast, many schools use low-cost tablets often without keyboards. Chromebooks and Microsoft Surface tablets occupy an intermediate position: low power, less flexible, but low cost and with keyboards useful for Microsoft Office apps. There is no data on the number of schools which require students to use Windows/Mac desktops/laptops.

## ***3. The isolation of digital K-12 in England***

Digital K-12 in England is fragmented and isolated, from the university sector (which provides much teacher training), from each other (no central agency or regional aggregation) and from other countries especially in Europe (most EU countries' exam systems are much more compatible with England than the US system is). In more detail, summarising and extending some points made earlier:

1. There is no central agency for ICT in schools. Becta was closed in 2011 - to dismay from experts (Preston, 2010; Selwyn, 2011).
2. There is no regional structure that is effective for digital support or procurement - 150 municipalities is far too many, thus many are too small.
3. Most schools do not use a full-function VLE which universities/colleges use.
4. There is no standard scheme to ensure that teachers have up-to-date skills in using ICT to support teaching. The topic is covered in courses for *new teachers*, but not for teachers already qualified. Few schools are large enough to mount such courses themselves.
5. University/college e-learning staff have the *Association for Learning Technology*, ALT (2023b), which is well known and has considerable traction; however, few school teachers are members.
6. The national inspection system for schools has little focus on ICT. The work from the EU, OECD, and other countries on quality schemes for ICT in schools is little known or used.
7. UK-EU collaboration in education ceased soon after the UK left the EU.

# Trends and Issues in Digital Learning

## Trends in digital learning

### *1. Increasing bandwidth to each school and pupil, at school and at home*

Bandwidth into schools is increasing each year. Especially during the pandemic, heroic efforts were made to increase it - *London Grid for Learning (LGfL)* upgraded nearly 3,000 schools (Cebr, 2021, p. 10). Yet still, primary schools "were significantly more likely to experience lower bandwidth delivery" (CooperGibsonResearch, 2021, p. 16).

Bandwidth demand, and supply, will continue to grow. The government requires all schools to have full fibre internet by 2025 (Department for Education, 2022f) with performance requirements as follows (Department of Education, 2023k):

- *Primary schools should have a minimum 100Mbps download speed and a minimum of 30Mbps upload speed.*
- *Secondary schools ... should have a connection with the capacity to deliver 1Gbps download and upload speed.*

However, 1 Gbps norm for schools (most less than 1,000 students) will be inadequate for the largest schools (see Table 6). There are three schools with 3,000 or more planned enrolment and several more with over 2,000. Such schools would even today need more than 1 Gbps.

**Table 6** Largest Schools in England - Planned and Actual Pupil Numbers

School	Planned #	Actual #
Nottingham Academy	3,570	2,337
Ashfield Comprehensive School	3,146	2,685
Walton High School, Milton Keynes	3,000	2,793

Note. Get Information about Schools, 2023; Open Education Wiki, 2023, Table S.1.

Although virtual reality and augmented reality are used only in a few schools (CooperGibsonResearch, 2021, pp. 72-73), usage will grow, especially for vocational courses in secondary schools, and as Ultra HD video extends into schools.

## ***2. Increasing the number and power of devices used***

In the last few years, universities in England recommend students to have a PC laptop. Thus students (or their parents) will have to buy/rent a laptop, in addition to paying £9,250 annually for university study. This financial approach is not an easy option for state schools with zero fees, but there are signs that some schools can now fund provision from state funds or donations (see Issue 3 on "the role of parents").

Currently, few face-to-face schools have a device:student ratio of 1:1 - a typical ratio is 1:4 (CooperGibsonResearch, 2021, p. 18) and most devices are not PCs, yet.

## ***3. Exams remain paper-based***

A levels are the exams used by universities to select students for higher education courses; GCSEs are used by schools to select who is best placed to benefit from A levels and by organisations to select for employment including apprenticeships.

England shares a common approach to GCSEs and A levels with Wales and

Northern Ireland, using four different exam boards. The exam boards operate as part of a hierarchy (Ofqual, 2020):

- The Department for Education sets the subject details that GCSEs and A levels must cover.
- Ofqual regulates qualifications, deciding which organisations can offer GCSEs and A levels, and sets rules that exam boards must follow.
- Exam boards develop, mark and award GCSEs and A levels, working in association to ensure common policies.
- Schools are responsible for teaching and learning, preparing students to take the qualifications and providing support after the results.

The exams are undertaken in a supervised situation, normally an exam centre at a specific time and date. Most subjects have two or three exams; some subjects grade coursework done at school. Most exams *require students to hand-write all their answers, including essays* - in fact, laptops are allowed mainly when some disability precludes handwriting (Think Student, 2022) rather than for all exams, as would seem natural in a digital world.

During the pandemic, exams were cancelled, students were awarded grades based on teacher predictions, and universities, employers and parents agonised over standards (Kippin & Cairney, 2022). This led to pressure for digital assessment - for many prior years there had been little interest in this (Mansell, 2009). Covid provided the stimulus - but researchers had already researched the issues and vendors gained experience in other countries.

In 2022 Ofqual announced a review of "whether greater use of technology in assessment and qualifications could deliver benefits for students and apprentices" and specifically mentioned "remote invigilation" (Education Hub, 2022). One exam board (AQA) also carried out research (Whittaker, 2022). Their full report was generally more positive than the cited article but flagged the need to upgrade school infrastructure and ensure home access. A forward-

looking conclusion was that such work should "enable the next wave of school development, allowing students to experience a rich curriculum while also preparing for its application in a digital world" - but there was a key caveat, that the initiative's success "relies upon on a government-led programme of national change" (AQA, 2022).

In summer 2023 Ofqual confirmed a study of the feasibility of "fully digital" exams (ParliamentLive TV, 2023).

#### ***4. Virtual schools growing but still peripheral***

Virtual schools first appeared in the United States. Hence an early definition is US-oriented: "an entity approved by a state or governing body that offers courses through distance delivery - most commonly using the Internet" (Barbour & Reeves, 2009).

In England, a virtual school often means something different - "a statutory service which exists to promote high aspirations for our children placed in care and previously looked after" (Worcestershire County Council, 2022) - correctly called a *Virtual School for Looked-After Children* (VSLAC). This normally uses teachers from several schools to teach such children - the virtuality is in the structure of the school, not in the *method of delivery*.

Virtual schools in the US sense started in the UK in 2005, when Interhigh was founded to teach online (King's Interhigh, 2005). Earlier, in 1963 the National Extension College started as a correspondence college - this began a move to blended provision (with some online) around 2000 (NEC, 2023).

There is currently no official data on the number of virtual schools or the number of students who are studying at them in England. The Department for Education is reported as estimating "25 online education providers" (Martin, 2023). All are private schools. Table 7 shows some virtual schools operating from England.

**Table 7** Virtual Schools in England

Virtual School	Ages	GCSE	A level	VLE
Kings Interhigh	7-18	Y	Y	Canvas
Harrow Online School	16-18	-	Y	-
My Online Schooling	7-18	Y	Y	Canvas
National Extension College	16-18	Y	Y	Moodle
Oxford Homeschooling	11-18	Y	Y	Moodle
Wolsey Hall	5-18	Y	Y	Canvas

Note. Lloyd, 2023; Open Education Wiki, 2023, Table V.1.

In addition to virtual schools offering the full range of schooling, there are other online providers in the UK who offer online tuition, GCSE or A level courses to adult students, resources to support homeschooling children and their parents, and US-style or international K-12 qualifications.

There was until 2023 no accreditation system for virtual schools (Department for Education, 2023e). The indicators for the scheme (Department for Education, 2023f) mainly ensure that the virtual school can be accredited as a school on the official list (Get Information about Schools, 2023) - there are only a few indicators on teaching and just one (2.6) on use of digital resources (Department for Education, 2023f, p. 15).

Virtual schools depend on computer hardware and internet for students at home. They require a PC-style laptop or desktop PC (not tablets or smartphones) plus a reliable broadband connection. They focus on reliability - tending to favour cloud-based, established systems from larger suppliers.

### ***5. Increasing role for centralised and open content***

*Open Educational Resources* (OER) are "learning, teaching and research materials in any format and medium that reside in the public domain or are under copyright that have been released under an open license, that permit no-cost access, re-use, re-purpose, adaptation and redistribution by others" (UNESCO,

2019, p. 2). England never had a K-12 OER policy and never funded any OER K-12 repositories, surprising since there was a large government-funded OER programme for universities in 2009-2012 (McGill, 2014).

Despite the universities OER project, most municipalities overseeing K-12 paid little attention to OER - excepting one where an OER expert had a senior role from 2010-16 (Fraser, 2015) - nevertheless just one school in that municipality still has a public OER policy (Rushey Mead Primary School, 2021).

There has been no central overall repository of digital K-12 content, OER or not. Specific collections popular in recent years include:

- Wikipedia (English) with over 6.7 million articles (Wikipedia, 2023c)
- Free image libraries such as Wikimedia and Flickr
- OpenLearn, from the Open University, with many free courses relevant to K-12
- TES Resources, with over 900,000 resources (TES, 2023), some free, others via schools subscription
- Pearson resources for teachers including free examWizard (Pearson, 2023a)
- Khan Academy - free online lessons and pioneering AI tools.

Subject teachers usually have access to specific collections or tools. These may come from (taking Latin as an example): universities (University of Warwick, 2023), subject teacher associations (ARLT, 2023) or specific government-funded projects (Centre for Latin Excellence, 2023) (Oak National Academy, 2023b).

One theoretical advantage of teaching in England is that there are open resources in other English-speaking countries - however, there is no evidence that teachers in England use Scottish resources or open content from MERLOT and other US K-12 repositories. One barrier to use may be the lack of categorisation of non-England teaching resources by the subjects and levels

used in England.

One feature familiar to universities who use modern VLEs is the ability to share *whole courses* and import courses which are openly licensed. Canvas allows all users access to Canvas Commons, its sharing platform; Moodle has something similar, Moodle.net. There is no evidence that course sharing of this sort happens in schools, unlike universities.

The key issue that came to the fore in the pandemic was the lack of *free* (or easily licensable) relevant content. The content did exist - many virtual schools and online K-12 providers had most subjects available online in both self-study and tutored form. Yet, government did not seem to want to license access to such material; instead it set up a new provider, *Oak National Academy*. This led to long delays in creating a critical mass of data, with large gaps (Martin, 2022) at the start of the 2022-23 school year.

After reflecting on the needs demonstrated very visibly during the pandemic, the government came to the view there was again a national need for a central repository, not one with a wide remit like Becta, but with a specific remit to provide online learning resources for the National Curriculum. A Full Business Case was published in October 2022 - the core analysis states (Department for Education, 2022c, p. 6):

*... two main curriculum problems exist: **weaknesses in curriculum design and delivery, ...; and excessive teacher workload associated with curriculum planning. ... have been exacerbated by the pandemic***

*... the key causes of these problems are that teachers are under-supported in the curriculum resources they have access to ... due to one or more of: **lack of buy-in to the value of full curriculum resources; lack of confidence in***

*the quality of the curriculum resources currently available; and difficulty in accessing and using high quality curriculum resources.*

The consultations leading up to this policy caused the usual backlash from teachers (Martin, 2022), unions, and content developers (Publishers Association, 2022) - and even some of the original Oak partners (Coles, 2022). There were the usual issues over teacher autonomy (NATE, 2023). Nevertheless, the National Academy is going ahead.

## **Issues in digital learning**

The "issues" discussed below have in common that there is no obvious consensus solution. Where feasible, some suggestions are given.

### ***1. Continued structural disorganisation in the school sector***

The wide variety of ICT systems used in schools leads to problems with support, training and resource sharing. The structural issues within the sector and the lack of group action do not help.

Some progress is being made. The Department for Education now has an effective regional structure based on the Government Regions, but still no regional component to handle digital issues. Academy Trusts play an increasing role in overseeing their schools, but many local education authorities do not manage digital strategy for their schools. In fact, a high percentage of both primary and secondary schools have no strategy or *school-specific* strategies - making group procurement hard or impossible (CooperGibsonResearch, 2021, pp. 76-77).

There are still around 5,000 small primary schools (enrolment under 200 students) (Weale, 2019) - unviable for an autonomous ICT strategy.

This situation leads to fragmented procurement, leading to no economies of scale or free added value services such as training. In contrast, UK colleges and universities have a more centralised/ regionalised/ group-oriented approach to procurement, which leads to a much smaller range of systems, and better support for these.

## ***2. Signs of convergence in Sixth Form Colleges for DL***

Sixth Form Colleges are set up to teach only A levels and equivalent vocational qualifications such as T-levels. Some of them were until recently in the FE College sector. This means that they teach subjects at levels which in some other countries (including Scotland and Canada) are taught at first year in universities. Initial information suggests that this is leading to a more university-like approach to systems, which may lead in time to convergence with post-secondary in ICT terms. Table 8 is a partial listing of Sixth Form providers with global VLEs (see Table 8).

**Table 8** State Sixth Form Providers and the University-style VLEs They Use

State schools	Type of state school	VLE
AbbeyGate Sixth Form College	Free School	Moodle
Ashton Sixth Form College	Academy	Canvas
Beverley High School	Local Authority School	Moodle
Blue Coat Church of England School and Music College	Academy	Moodle
Chester International School	Studio School	Canvas
Salford City College Group	Academy Trust	Canvas
St Mary Redcliffe and Temple School	Voluntary Aided School (Faith School)	Moodle

Note. Open Education Wiki, 2023, Table L.1.

The Sixth Form Colleges Association (SFCA), representing the 110 Sixth Form providers in England and Wales (SFCA, 2023b), makes a key point about flexible learning and VLEs in its strategy development paper (SFCA, 2023a):

*sixth form colleges ... realise that students are more likely to be successful when they have **independent, critical thinking skills**, and are therefore conscious of how their digital strategy, **including a virtual learning environment (VLE)**, can facilitate this*

In terms of staff development, software platforms compatible with universities and colleges would facilitate the construction of teacher training courses by universities-schools consortia and of self-study or tutored courses for A level subjects, and, importantly, their use by teachers and students, as the systems would be more familiar and transfer of content simpler.

For device aspects see below.

### ***3. Unclear role of home and parents in DL***

There are a number of home- and parent-related areas in digital K-12 where there is a long-standing reluctance of government to confront key issues. The main ones are:

- Homework, with the vagueness over the value and amount - discussed earlier.
- A reluctance to monitor homeschooling (discussed earlier) and the challenge of children not in school. After the pandemic, the Children's Commissioner (2022) revealed "tens of thousands of children who are persistently or severely absent or missing from education altogether".
- Vagueness about whether government, municipalities, schools or parents will fund the "one laptop per child plus broadband" needed at home to make ICT in schools really work. This is in addition to the laptops or desktops needed within each school.

There is no recent published research on the extent to which 1:1 access to a suitable device (tablet or laptop) has been achieved - but initial indications

(see the Table below) are that a small but steadily increasing set of schools of all types are doing this, for some age groups (see Table 9).

**Table 9** A Small Selection of Schools with 1:1 Provision of Devices

School	Type	Devices	Reference
Ark Schools	Academy Trust: 40 schools	Chromebook laptops	"a Google Chromebook from year 3, together with access to ... 'Office 365' applications from ... whatever device they are using" (Ark Acton, 2023)
Oldham Sixth Form College	Academy 16-19 Pinnacle Trust)	Chromebook laptops	(OSFC, 2023)
Eton	Private: boys Very high fees	iPads	(Eton, 2023)
Wycombe Abbey School	Private: girls High fees	MS Surface laptops	(Wycombe Abbey, 2021)
Manchester Grammar	Private: boys Medium fees	MS Surface laptops	(Whitewar, 2021)
Birkdale School	Private Medium fees	Chromebook laptops	(Birkdale School, 2023)

The examples of the Ark Schools Trust and Oldham College show what can be done within state school budgets, suggesting that the key constraints are motivation not finance. An iPad can be leased and supported for £120 per year (KRCS, 2023), within the overall framework set by the government (Department for Education, 2023b).

However, there are few signs yet of any schools adopting a PC laptop policy for pupils.

#### ***4. Unwillingness to change the school day or year to support DL***

There is no evidence of any schools in England adopting a significantly different length of or pattern to the school day because of blended learning. The

school week in England is defined as a "a 32.5-hour week" - an average 6.5-hour day (The Key Leaders, 2023). The length of a school day is "tightly distributed" between schools (Long, 2023, p. 17). There have been years of discussion on the benefits of a *longer* school day - in contrast, there is little discussion of the benefits of a *shorter* school day (Juni Learning, 2023) facilitated by DL.

There is an approach, "study leave", which allows older children to stay at home while studying for exams (Nash, 2023), when they could use online resources. However, this approach does not apply during days when teaching takes place at school.

In England, local authority-maintained schools have to open for at least 190 days in the school year (Long, 2023, p. 4). Tradition and parental expectations mean that schools all divide the school year into three terms with similar dates. There are discussions about changing school terms: in particular, the summer holiday is felt by educators to be too long. During the end-phases of the pandemic, suggestions were made for "longer school days and shorter holidays" to help students overcome the learning gap that Covid produced - these led to strong fight-back from teachers (Miller, 2021) and were never implemented.

## ***5. Use of artificial intelligence and other advanced technologies in schools***

Few schools use any artificial intelligence or virtual/augmented reality technologies (CooperGibsonResearch, 2021, p. 18). Yet, such technologies, along with Robotics and Blockchain, are seen by futurists, in the Future Opportunities report (Vicentini et al., 2022, p. 26) as soon to be deployed operationally, not just as experiments.

### *Artificial intelligence*

In the 2023-24 school year, artificial intelligence - mainly via language model

tools such as ChatGPT - will continue to integrate into school-level education. This includes the use of tools by both teachers and students alike. In the 2022-23 school year, teachers in many schools were discussing the issues surrounding AI and how it would impact on assessment, both in-school and high-stakes national (GCSE and A levels). The government released initial guidance in March 2023 (Department for Education, 2023g) along with detailed guidance from the Joint Council for Qualifications (2023). Later, the government issued a *Call for Evidence* to further inform their future policy development (Department for Education, 2023a). The *Teacher Development Trust* (2023) has produced a guidance document with comprehensive information.

The view from K-12 experts, such as Professor Mike Sharples, who led the Becta CAPITAL project, is that such tools "should be used to enhance pedagogy, rather than accelerating an ongoing arms race between increasingly sophisticated fraudsters and fraud detectors" (Sharples, 2022). However, there are likely to be a few "difficult" years for AI in schools in the immediate future, reminiscent of when pocket calculators arrived (Watters, 2015).

### *Blockchain*

In contrast, blockchain, though featuring strongly in recent research (Vicentini et al., 2022) is in the view of the authors not likely to be directly relevant to the schools sector for some years. Blockchain has become an EU priority (European Commission, 2023a), in particular to underpin a new model of modular qualifications - *microcredentials* (European Education Area, 2022). However, England already has a long-standing *well-developed* microcredentials system (Ofqual, 2023).

### *Robots*

Robots bring together both the advantages and the costs of augmented reality and artificial intelligence. Some thoughtful meta-analyses have been published (Karim et al., 2015). However, there is also a great deal of hype which confus-

es autonomous robots with passive devices which are stands holding a camera, screen and microphone. Press reports such as *AV Robots helps children stay in school* (Warwickshire County Council, 2023) seem unaware of the many hospital schools supporting pupils with standard online tools (Sheffield Teaching Hospitals Trust, 2023).

### *Virtual reality and augmented reality*

VAR, in other words, Virtual/Augmented Reality, is slowly being deployed in schools (CooperGibsonResearch, 2021, p. 130), Table 52 - despite one meta-analysis (Lou et al., 2021) noting that "Research findings on VR-based education have been conditional and inconclusive." VAR makes substantial power and thus cost demands on both devices and networks and is likely to appear first in vocational training and university teaching before widespread use in schools.

## **Conclusion**

This chapter reviews the current state of digital K-12 in the United Kingdom with emphasis on England. It paints a picture of digital schools giving evidence to substantiate the UK's high ranking in digital maturity studies and analyses.

The chapter begins by summarising the K-12 system in England and the factors of the National Curriculum and National Exams which produce a uniform system despite the wide variety in size, purpose, organisation and funding of schools.

It describes the policy interventions, funding schemes, large-scale projects and influential reports in the 18-year period 2005-23, demonstrating that deci-

sions taken more than ten years ago have continuing effects today, and that the pandemic rapidly accelerated existing trends rather than setting a brand new direction.

A broad view is taken of infrastructure covering technology, leadership, budgets, course design/delivery, ensuring student success, staff development, quality and inspection, and analytics. It provides data and examples for the main trends analysed - bandwidth, school networks, software, end-user devices, and content.

It covers topics often omitted in such reports, such as private schools, home-schooling, virtual schools, open content, online national examinations and the overlap of K-12 with the post-secondary sector.

It reviews key issues: structural disorganisation leading to fragmented procurement of a plethora of systems, the multi-dimensional isolation of K-12 including the disconnect between school and post-secondary digital approaches and systems, lack of clarity on the role of parents, the rigidity of the school day/week/year limiting the scope for blended digital learning, and the promise but problems of advanced technologies.

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