Department for Education

Implementation of education technology in schools and colleges

Research report

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CooperGibson Research

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Executive Summary

Due to significant developments in the use of education technology (EdTech) in schools and colleges since the COVID-19 pandemic, the Department for Education (DfE) has initiated a programme of research to understand what works in EdTech to establish a strong evidence base for effective use of technology and embed this across the school system, so that it is easy for schools and families to use the best products at the right time.

To inform this programme of work, the DfE commissioned CooperGibson Research (CGR) to conduct research exploring how new education technology is successfully implemented and embedded in schools and colleges. The project aimed to develop an understanding of the key features or approaches that schools or colleges need to take to successfully implement and embed new technology. The findings of which will help the DfE to better advise schools and colleges on selecting the right technology for their setting.

Methodology

A qualitative approach was designed involving:

- A virtual roundtable meeting with key EdTech stakeholders to identify a potential sample of schools and colleges which have implemented technology successfully and to inform design of the research materials.
- A rapid literature review of previous research to add contextual understanding from previous EdTech implementation studies.
- An engagement and screening survey to identify schools and colleges that had implemented new technology well.
- In-depth interviews with schools and colleges that had recently implemented new education technology to explore the process of implementation and identify key success factors.

In-depth interviews were conducted in February and March 2022 across 17 schools and colleges (13 schools and 4 colleges) which had successfully implemented new technology in the past 2 years. A further 4 interviews were conducted with 3 schools and 1 college, which had examples of where implementation of education technology had been less successful. In total, interviews were conducted with 48 respondents.

In the schools and colleges which had successfully implemented new technology, interviews were conducted with up to three staff members (a senior leader, a technical / digital lead or middle leader, and a staff member that had used the technology in their

role). This allowed strategic, operational and user perspectives, to be included in the research.

Key findings

The research identified the key stages that schools and colleges considered to be important when implementing technology. Following a sequential and structured process, schools and colleges highlighted the importance of preparing for technology implementation (for example, identifying needs and sourcing appropriate EdTech), ahead of the implementation process itself. Alongside this, the feedback from schools and colleges highlighted training and support and monitoring processes as underpinning the planning and implementation process.

Identifying needs

Schools and colleges being clear about the specific need or priority that EdTech was aiming to address was a critical starting point. For most, improving teaching and learning was the primary driving force behind decisions to introduce all types of technology, whether directly or indirectly, alongside reducing workload or increasing efficiency, improving pastoral support or communication and the fulfilment of a digital vision or strategy.

Schools / colleges used mixed approaches to identifying EdTech and their needs, including top down and bottom up. This included using formal reviews, staff consultation and identification, and where the EdTech lead or team had researched and identified technology that would meet the needs of the setting.

Having a digital vision or strategy, that aligned or integrated with curriculum goals and improvement plans ensured that the technology implemented was relevant and helped the setting to achieve their goals. A strategy that looked to the future and was tailored to the needs and context of each setting was also important.

Informed decision making

Key to successful implementation was informed decision-making and there was evidence that schools and colleges were using multiple sources of information for researching EdTech (such as seeking recommendations from education professionals and trusted EdTech partners, and seeing how technology worked in an educational setting). Collaborative decision-making was also important for ensuring that decisions on implementing new technology were robust and considered

Considerations when deciding to implement technology included:

- Whether the technology meets the needs of staff and / or learners.
- Its alignment or integration with the infrastructure already in place.
- Ease of use and accessibility including consideration of staff confidence and skills, and whether the technology is suitable for different types of learners (for example, whether it could be used across different year groups or abilities).
- Cost of implementing the technology and the budget available, including ongoing maintenance / renewal costs and maximising the use of free tools.

Piloting or trialling EdTech

Piloting supported schools and colleges by allowing them to explore effectiveness, impact and potential challenges and issues ahead of technology implementation. The piloting process had parallels with implementation (but on a smaller scale) and generally involved an initial test of the technology, planning for the pilot (for example, setting objectives, roles and responsibilities, feedback mechanisms), user testing and then review or evaluation.

Piloting was reported to be successful where it included:

- Staff and / or learners with a range of skills and confidence involved in testing the technology.
- Utilising a ‘test’ and ‘control’ group approach.
- Ring-fencing time for staff to explore and pilot new technology.
- Reflecting on the lessons learned from the pilot.

EdTech implementation process

The stages that schools and colleges went through to implement and embed EdTech were varied and dependent on the type of technology being implemented (for example, the scale and focus of the EdTech). The stages for implementing EdTech broadly included: planning for implementation; assessing and preparing the infrastructure; driving, encouraging and supporting use; and streamlining integration.

Planning for implementation worked well where schools and colleges had:

- Reviewed the pilot data to help shape the wider roll-out, identifying any issues or challenges to address.
- Established a clear timeline and plan for roll-out that considered staff responsibilities and timings.
- Agreed and set clear expectations for use.

Preparing the existing school / college infrastructure for technology was an important step, particularly where whole-school / college systems were being introduced or where the scale of technology to be introduced would have a significant impact on the existing infrastructure or ways of working. Where schools and colleges had found this to work well, they had:

- Undertaken an infrastructure audit to assess the suitability of current technology.
- Allowed time for technical staff to test the technology prior to roll-out.
- Addressed the practicalities of implementing EdTech (for example, access for learners and staff).
- Addressed how new EdTech systems could be integrated with existing systems.
- Considered how the EdTech could be easily accessed remotely.

Engaging users (staff, learners and parents/carers) in EdTech implementation was pivotal in ensuring that technology was implemented well, and users were equipped with the skills, confidence and capability to use the technology. Alongside training and support, mechanisms which were central to user engagement were:

- Communicating the vision and approach for EdTech. This included clear messaging about its purpose, strong communication from SLT, communicating with staff at all levels, and using multiple communication approaches with consistent messaging to help reinforce messages.
- Senior leadership engagement and commitment. This involved demonstrating a willingness to adapt their own practices, dedicating sufficient resources (such as finance and staffing), and allocating appropriate staff (such as digital leaders, EdTech leads), to drive forward implementation.
- Integrating EdTech within wider systems to further embed its use and support alignment with other mechanisms and processes. For example, aligning with qualification assessment criteria, teaching and learning, wider school systems, and changing existing school policies to align with EdTech use (such as, amending marking policies).

Training and support

Adopting flexible, ongoing training and support throughout implementation was viewed by schools and colleges as being critical to normalising technology use and encouraging user engagement. Schools and colleges offered training and support opportunities that:

- Were underpinned by a strong framework which had considered existing professional development structures (for example in-service training and induction

days), resource allocation, the balance of technical and pedagogical support, and trainer expertise.

- Were continuous but phased and built-up staff knowledge and confidence steadily, by starting with basic training and then providing more in-depth or intensive training as required.
- Used different formats that allowed users to access training via multiple means, creating efficiencies in time, whilst recognising that face-to-face training remained important. Using remote approaches, bite-sized resources, and keeping the structure and content of training simple were all ways in which this could be achieved.
- Allowed users the time to practice and adapt to technology. For example, offering opportunities to see the EdTech in practice, differentiating and personalising training and support (including offering training at different levels), and developing a peer-to-peer model of support or community of practice.

Monitoring use and effectiveness

Schools and colleges were able to give examples of monitoring approaches that they had established, to check how well technology was being used and embedded. Primarily, this included:

- Seeing EdTech in practice in a teaching and learning environment using approaches such as learning walks, classroom and teaching observations and work scrutiny.
- Monitoring EdTech usage to understand whether technology was being used as intended. There were examples of schools and colleges monitoring frequency of use (such as monitoring log-ins), which lessons EdTech was being used in and tracking the number of users.
- Collecting frequent user feedback (from staff, parents/carers and learners) on technology introduced including surveys of learners, staff and parents/carers, ongoing discussions with staff using formal or informal mechanisms, and developing impact case-studies.

Schools and colleges recognised that it was more challenging to quantitatively measure the impact of technology implementation on learner and staff outcomes (for example, on learner progress and staff workload reduction) in a robust way, although they were attempting to do so in some cases.

Challenges

At an infrastructure level the challenges mentioned by schools and colleges were focused on the ability for infrastructure to support new technology being introduced, having the available budget to purchase technology (including being able to meet the ongoing costs of EdTech upkeep), the capacity of technical staff to implement new EdTech, and the integration of new EdTech with existing systems to ensure compatibility and alignment.

At a teaching and learning level, challenges included the tension of wanting to test and implement new EdTech with consideration of the impact on learner outcomes, the impact on the teaching and learning models and teachers being creative enough to understand how best to utilise EdTech within their teaching.

At a user level the differences in staff capabilities, confidence and willingness to use technology was seen as a challenge, alongside keeping staff engaged with the technology (for example, if technical issues arise). The willingness of learners and parents/carers to engage in technology use, alongside wider issues of digital poverty and literacy were also identified as being challenges by the schools and colleges involved in the research.

Benefits and impact of technology use

Schools and colleges were able to provide their perspective on the benefits and impact they had seen from introducing EdTech, whilst recognising that EdTech had been introduced for various functions and reasons, and that it was also challenging for schools and colleges to isolate observed impact of a specific type of EdTech. Impacts were reported on:

- Staff, including on staff workload particularly (reducing the time spent planning lessons and marking work). Impacts on increasing staff confidence and skills in the use of EdTech, enhancing and encouraging creativity in teaching and supporting assessment processes, were also reported.
- Improvements in learners' engagement and confidence in their learning, independence, learning progress, quality of work produced and improvement in communication between learners, peers and teachers.
- Parents/carers having a clearer understanding of the expectations of the school or college, greater engagement in their child's learning and increased attendance at parents' evenings.

1. Introduction

As defined in the Department for Education (DfE) EdTech Strategy, *Realising the Potential of Technology in Education* (2019):

> Education technology (EdTech) refers to the practice of using technology to support teaching and the effective day-to-day management of education institutions. It includes hardware (such as tablets, laptops or other digital devices), and digital resources, software and services that help aid teaching, meet specific needs, and help the daily running of education institutions (such as management information systems, information sharing platforms and communication tools).[1]

Following significant developments in the use of EdTech in schools and colleges since the COVID-19 pandemic, the DfE has initiated a programme of research to understand what works in EdTech, to establish a strong evidence base for effective use of technology and embed this across the school system, so that it is easy for schools and families to use the best products at the right time.

To inform this programme of work, the DfE commissioned CooperGibson Research (CGR) to conduct research to explore how new education technology is successfully implemented and embedded in schools and colleges.[2]

Understanding the key features or approaches that schools or colleges need to take to successfully implement and embed new technology in the school or college, will provide evidence to the 'What Works in EdTech' programme, helping the DfE to better define what makes a 'good' EdTech product and to advise schools and colleges to select the tools that are right for their setting.

1.1 Research objectives

The research was designed around the following research questions:

- How do schools and colleges select which EdTech products (hardware or software) to invest in?
- How do schools and colleges implement the products successfully?

[1] Realising the potential of technology in education: A strategy for education providers and the technology industry, (2019), p5.
[2] This project makes up a programme of work with three other projects being commissioned at the same time around: (1) Understanding the market, (2) Future opportunities in EdTech, and (3) A deep dive into remote teaching. The four projects will feed into the design of the main three year programme.

- What are the critical success factors for a school or college to be able to embed a new product well?
- Do some EdTech products work better in different types of educational settings (eg. size, phase, key stage etc.) or for different levels of digital maturity?
- What are the barriers and challenges faced by schools and colleges when implementing and embedding new technology and how are they overcome?
- What impact does the use of this new technology have (on workload, learner progress and engagement, costs etc.) and what are the key features of the implementation/embedding process which cause these impacts?

1.2 Methodology

In order to explore EdTech implementation in detail, a qualitative approach was designed involving:

- A virtual roundtable meeting with key EdTech stakeholders (10 attendees representing the DfE, EdTech trainers, education bodies and charities, schools and colleges), to help identify previous research to feed into the rapid literature review, shape the research themes, and identify a potential sample of schools and colleges which have successfully and unsuccessfully implemented new technology.
- A rapid literature review of previous research to add contextual understanding from previous EdTech implementation studies and to help with the development of topic guide questions and analysis themes. This review can be found in Appendix 3.
- An engagement and screening survey to identify schools and colleges that had implemented new technology. The outcome and findings of this survey can be found in Appendix 1.
- In-depth interviews with schools and colleges that had recently implemented new education technology, the findings of which are detailed in sections 2 to 10 of this report.

1.3 Engagement and screening survey sample

To supplement the virtual roundtable as a source for school and college recruitment, a short online survey was sent to 565 schools and 252 colleges to further identify schools and colleges for involvement in the research. The sample of schools was selected from the register of schools and colleges in England, 'Get information about schools' (GIAS), using a stratified random sampling approach (stratified by phase and type). Sampling of

secondary schools was upweighted to increase the numbers of responses achieved for the qualitative sample selection (primary 415, secondary 150).

The survey was completed by 43 schools and 28 colleges between 2nd February and 1st March 2022. In total, 27 respondents gave permission to be contacted for further research about education technology and these schools (10 primary schools, 5 secondary schools and 12 colleges) were used alongside the roundtable recommendations for interview selection. A summary of the data from this survey is detailed in Appendix 1.

1.4 Interview sample

In total, 81 schools and colleges were identified as potential contacts for the qualitative interview sample from a combination of roundtable recommendations and screening survey responses. To aid the selection of schools and colleges for the in-depth interviews, initial short telephone calls were conducted with a senior or EdTech leader to identify:

- Function / area of the school / college that the new technology had been implemented in (administration, teaching and learning, pastoral support).
- Type of technology (hardware, software, infrastructure).
- Stage in the implementation process.
- Extent of implementation (school / college-wide, group-wide, some departments).
- Perceptions of implementation success.

The focus for sample selection was on schools where implementation was perceived to have been successful to provide an understanding of 'what works' when implementing new technology successfully. The final selection of schools was informed by the initial conversations about the new technology that had been implemented and why it had been successful, to ensure a range of different functions and approaches were included. A mix of school phase, type and size was also included across the sample.

Each selected school / college where EdTech was perceived to have been implemented or embedded successfully, was contacted by email to request their participation and nomination of appropriate members of staff who would be able to participate in the interviews. Schools / colleges were asked to nominate up to three members of staff:

- A senior leader - to explore the decision making process for identifying and selecting new technology and gain a strategic view on how it was implemented and embedded.

- A technical / digital lead or middle leader - to explore their role and the process of selection and implementation of new technology.
- A staff member - to understand the experiences of those using the new technology in their role.

Schools / colleges where EdTech implementation had been less successful were also included in the sample, to provide a point of comparison and examples where implementation had not worked as well. A single interview was conducted with an EdTech leader in these schools.

The schools and colleges interviewed had implemented a range of EdTech over the previous 2 years. The types of EdTech discussed included software (such as teaching and learning tools), hardware (such as one-to-one devices) and infrastructure (such as cloud storage) and it was common for EdTech to be used across multiple functions. The functional areas where new technology had been implemented that schools and colleges discussed in the interviews included school administration, timetabling, pupil data management, data storage, parental communication, planning and delivering lessons / curriculum content, assessment, pastoral support and delivering training.[3]

1.4.1 Sample profile

In-depth interviews were conducted in February and March 2022 across 17 schools and colleges which had successfully implemented new technology in the past 2 years (13 schools and 4 colleges). The profile of these schools is detailed in Table 1. Four of the primary schools and 2 of the secondary schools were part of the EdTech demonstrator programme[4].

[3] Many schools and colleges implemented technology to support remote teaching and online live lessons due to school and college closures as a result of the COVID-19 pandemic, however this was not the focus for this research (see section 1.5).
[4] The EdTech demonstrator programme was developed by the Department for Education to ensure schools and colleges could access free, expert advice on educational technology from a network of 42 demonstrator schools and colleges. https://www.gov.uk/government/publications/edtech-demonstrator-schools-and-colleges-successful-applicants/about-the-programme

Table 1: Profile of schools / colleges (successful implementation)

School / college profile	Number of schools / colleges
Phase	
Primary	6
Secondary	7
College	4
Type of school	
Single academies / free schools	2
Local Authority (LA) schools	3
Part of a multi-academy trust (MAT)	8
Type of college	
General further education (GFE) college	3
Sixth-form college	1

Interviews were conducted with 44 respondents across the 17 schools / colleges which had successfully implemented new technology. In some cases, EdTech leaders were also members of senior or middle leadership teams and in 2 schools a combined senior leader and EdTech lead interview was conducted with one respondent. The role of respondents participating in the successful implementation interviews is detailed in Table 2.[5]

[5] Respondents with dual roles as EdTech leader and senior or middle leaders have been represented as EdTech leaders.

Table 2: Role of respondents (successful implementation)

Respondent role	Number of respondents
Senior leader	13
EdTech leader	17
Middle leader	6
Teacher	5
Teaching support / administration staff	3

A further 4 interviews were conducted with EdTech leads at 3 MAT schools (2 primary schools and one secondary school) and one GFE college, which had examples of where implementation of education technology had been less successful. Two of the schools had also participated in the successful implementation interviews and were part of the EdTech demonstrator programme.

1.5 Methodological considerations

There are a number of methodological considerations to note when considering the findings provided in this report:

- The schools / colleges were purposefully selected to include examples where implementation of EdTech had been successful or unsuccessful. Furthermore, the schools and colleges identified by the roundtable and to an extent those responding to the engagement and screening survey, were typically more advanced with regards to their use of EdTech and a number were part of the EdTech demonstrator programme. As such the sample for this research is not representative of all schools and colleges in England.
- Four research projects exploring the use of EdTech in schools / colleges were being conducted concurrently and it was necessary to ensure that the same schools / colleges were not included in multiple projects to reduce burden and avoid further sample bias across the projects. As such, some of the schools identified for potential inclusion in this research were excluded as they were already being contacted for another what works in EdTech research project.
- During 2020 and 2021, many schools and colleges implemented new technology to support remote teaching and online live lessons due to school and college closures as a result of the COVID-19 pandemic. This implementation was, in many cases, driven by the pandemic and did not reflect the usual practices of new technology implementation. Furthermore, one of the other projects being

conducted concurrently focused on remote teaching. This research therefore aimed to focus on implementation of new technology used for other functions.

1.6 Notes for reading this report

In exploring the key features or approaches that schools or colleges need to take to successfully implement and embed new technology, the research identified several stages of implementation and key considerations. This report has therefore been structured around the following key sections:

- Identifying needs.
- Informed decision making.
- Piloting or trialling EdTech.
- EdTech implementation process.
- Training and support.
- Monitoring use and effectiveness.
- Challenges.
- Benefits and impact of technology use.

It should be noted that there was considerable overlap in the considerations and processes that schools and colleges go through at the different stages of EdTech implementation, therefore the findings across all of the sections in this report should be considered together to inform 'what works' in EdTech implementation, rather than any one section individually.

2. Identifying needs

This section explores the rationale for implementing EdTech, including how schools and colleges successfully identify their needs and the EdTech that will meet those needs.

2.1 Rationale for introducing EdTech

As identified in the literature review (see Appendix 3), clarity on the specific need or priority that technology would address was a crucial starting point for schools and colleges when selecting EdTech, as described by one secondary school senior leader:

> It should never be about the tech, it should really solve a problem that exists. – *Senior leader, Secondary school*

Understanding the needs of their setting, therefore, and identifying how any new technology would meet those needs was key to ensuring that implementation would be successful. These needs (or rationale) broadly fell into four themes:

- Improving teaching and learning.
- Reducing workload or increasing efficiency.
- Improving pastoral support or communication.
- Fulfilment of an EdTech vision or strategy.

The schools and colleges interviewed often cited multiple rationale underpinning their decisions about the technology that would meet their needs.

Practice example – multiple rationale underpinning decisions

Teaching staff at a small rural primary school identified the need to provide additional support for learners undertaking the statutory multiplication tables check (MTC) in year 4. They decided to implement maths software with the rationale that it would tackle this need by improving teaching and learning (by improving learners' multiplication skills), reducing teacher workload (because learners could work independently) and it would fulfil their vision of a consistent approach to the technology used to support learning across the school.

Improving teaching and learning was ultimately cited as the primary driving force behind decisions to introduce all types of technology, whether directly, or indirectly. For example, a secondary school described how implementing software to improve the efficiency of producing reports from the schools' management information systems had enabled staff to be more proactive in tackling learner behaviour and absence and to spend more of their time on tasks impacting on teaching and learning rather than interrogating data.

Importantly, ensuring technology selection was informed by pedagogy and an understanding of how it could effectively enhance learning was key for successful implementation, rather than 'tech for tech's sake', as noted in the literature review (see Appendix 3).

Practice example – technology selection informed by pedagogy

An EdTech lead at a primary school explained that their approach to technology was increasingly driven by pedagogy and to support this they ensured that the implementation process was always owned by a member of staff with subject or pedagogical knowledge. This enabled them to ensure that they were addressing the need and not trialling new technology without real pedagogical foundation.

> Over time we pivoted from products to principles, and we are even more nuanced now in some of these live lessons, now looking more at pedagogy, PEDTech, approaching it from a PEDTech perspective. – *EdTech lead, Primary school*

2.2 Approaches to identifying needs

A range of approaches were used to help schools' and colleges' to successfully identify needs and the technology which may meet those needs. Approaches fell into four broad categories:

- Formal review - review of strategic goals at the whole-school / college or MAT level to identify current and future technology needs. Typically, these reviews fed into the development or updating of their EdTech strategy. Frameworks were used by some schools / colleges to support the process of identifying needs and/or subsequent implementation (see section 3.4).
- EdTech lead driven - where an individual or team with responsibility for EdTech within the school / college or trust would research and identify technology that would meet the needs of the setting. The EdTech lead would typically consult with senior leaders and information technology (IT) departments or external IT support providers to discuss the suitability of technology.
- Staff consultation - regular or occasional meetings or consultations with staff where discussion of technology that may meet the setting's needs was the sole purpose or formed a specific point on a wider meeting agenda.
- Staff identified - this approach was mentioned where teaching staff had alerted senior leadership about a specific need or where they had identified technology which could address an issue, for example, within their subject, department or year group.

Practice example – identifying needs across schools in a MAT

An EdTech lead from a large mixed-phase MAT described the process of identifying the needs of their trust as a whole and the needs of individual schools as like ‘the layers of an onion’:

The ‘core’ systems at the heart of all of the schools, such as management information systems (MIS), were chosen by a central team in consultation with the schools in the trust.

In the next ‘layer’ were the recommended technologies that had good evidence that they worked well, or that they had seen working well in another school. These technologies would also be implemented across the trust.

The final ‘layer’ was optional technology, which typically included tools that were implemented on a smaller scale. For example, an app to support reading for pleasure was identified by an executive principle as being useful for SEN learners and was implemented in two of their special schools.

The senior leader noted that tools could shift through the ‘layers’, for example, optional technology could move up into the recommended technologies layer if evidence of impact on learning had been measured.

2.3 Digital strategy and vision for EdTech

All except two schools and colleges involved in the research already had some form of EdTech strategy in place. One college was in the process of developing a strategy and one small primary school did not have a formal strategy for EdTech.

Having an EdTech strategy was described as an important part of successfully identifying needs and ensuring that the technology implemented was relevant and helped the setting to achieve their goals. EdTech strategies included details such as the setting’s vision and goals, analysis of their needs, their overall approach to technology and how it should be used, EdTech roles and responsibilities, infrastructure plans and the training needed. In some cases, a formal EdTech implementation process for piloting and / or roll-out was included in the strategy. It was also important that the strategy looked to the future and included consideration of how needs and technology may change over time.

EdTech strategies were tailored to the needs and context of each setting. For some settings, technology was cited as being increasingly at the heart of their vision and integration of their EdTech strategy within wider organisation improvement or curriculum plans (rather than separately) was important to ensure that the technology implemented really supported that vision and enhanced their curriculum offer.

> Increasingly it's becoming more integrated. […] I don't see really that it should sit separately, it should be fundamental to the organisation's strategy and threaded through it. So, although we have a formalised digital strategy it is increasingly threaded into our organisational strategy. – *Senior leader, GFE college*

2.4 Summary of what works when identifying needs

- Clarity about the specific need or priority the technology is aiming to address is a crucial starting point for successful EdTech implementation, 'not tech for tech's sake'.
- Utilising mixed approaches to identifying EdTech and needs, including formal review of strategic goals across the school / college / MAT, research conducted by an EdTech lead or team, EdTech focussed staff consultations and ad-hoc identification from staff.
- Having an EdTech vision or strategy, aligned or integrated with curriculum goals and school / college improvement plans, is an important part of successfully identifying needs and ensuring that the technology implemented helps schools / colleges to achieve their goals.

3. Informed decision making

Successful implementation was also underpinned by ensuring decision making was fully informed, utilising multiple sources of information. This was particularly important for large scale or organisation-wide technology implementation.

Successful, fully informed decision making included:

- Consideration of the goals or needs that the technology was aiming to address (see section 2).
- Thorough researching of available technology which may meet those needs.
- A collaborative decision making process.
- Consideration of key factors such as cost, infrastructure, accessibility and ease of use.
- Use of frameworks to support strategy development, decision making and implementation processes for some settings.

Practice example – learning the importance of informed decision making

The importance of fully informed decision making, was highlighted by a senior leader from a large, mixed-phase MAT. The trust wanted to implement new timetabling software to support consistency across the trust and allow for collaborative working across all the schools, such as masterclasses led by an expert based in one school to be offered to learners across the MAT. The software chosen was one of the market leaders, with excellent marketing and the favourite option amongst those responsible for timetabling. However, a thorough pilot carried out in seven schools identified that the software was not able to work at the scale required, did not allow the functions expected and did not integrate with the management information system of the trust.

As a result of the pilot, the MAT did not proceed with roll-out to all its academies and had to conduct a new pilot with a different piece of software, with cost and time implications. On evaluation, the EdTech lead identified that a larger number of solutions should have been researched and piloted in parallel to allow for comparison of performance. This understanding became a learning point for the EdTech team, who use the experience as a reference for EdTech implementation.

> In hindsight, our reasons for piloting that particular product were not sound enough. We went with it because it was shiny, it was one of the market leaders. – *EdTech lead, Mixed-phase MAT*

3.1 Researching and sourcing technology

Three common sources emerged for researching education technology:

- Recommendations from education professionals.
- Information from technology providers.
- Advice from other EdTech partners.

3.1.1 Recommendations from education professionals

Recommendations from other educational professionals was often described as the best way to identify 'what works' when choosing education technology. This approach allowed settings to share experiences and ideas, identify the potential pitfalls and challenges around implementing and using technology and better understand how EdTech products worked in the real-world environment of a school or college.

> Actually going into a school and speaking to real teachers and finding out from them what the difficulties were, because none of the products will be perfect. But asking people who have used it in teaching and hearing an honest answer, hearing about the day-to-day management of the devices and how useful they are was extremely helpful. – *EdTech lead, Primary school*

Valuable sources of advice and recommendation included:

- Staff in their own setting - both formally via meetings where review of EdTech was the sole purpose of the meeting or a specific point on the agenda, and informally through general discussions between department staff or teams, with the EdTech lead/s or with SLT.
- Colleagues in other settings - such as other schools in their MAT, cluster or other local settings and EdTech demonstrator schools or colleges.
- Social media - such as education professional forums and educational groups on social media platforms.

  > It's really important to be on the forums, to know what schools are implementing, what is current and what works well. – *Senior leader, Primary school*

- Educational bodies or associations - such as the Sixth Form Colleges' Association, Education and Training Foundation (ETF), Education Endowment Foundation (EEF).

The importance of speaking to schools who have experience of technology before implementing it was illustrated by an EdTech lead at a small primary MAT. The school purchased 3D printer technology which they had seen at a conference and had 'looked wonderful'. Due to the high cost of the technology, they decided to invest in a small number of 3D printers and five resource sets to work alongside a piece of software. However, they had not spoken to any other schools that had implemented the technology or considered whether implementation of the technology would work in such small numbers in a class context. The limited number of devices meant that learners needed to work in groups which caused classroom management difficulties. As a result, staff were reticent to use the technology in their classes.

3.1.2 Information from technology providers

In addition to recommendations from colleagues, information from technology providers was sought through internet searches, communication and demonstrations from technology providers or via technology events such as the British Educational Training and Technology Show (Bett)[6]. One EdTech demonstrator primary school described how they are regularly approached by technology companies to test products, because they are known for their use of technology and have a high profile on social media.

Where settings had chosen to focus on one major platform, such as Microsoft, Google or Apple, exploration of the tools available from their provider was an important source as they would be easily accessible, integrate with systems already being used, have the benefit of the support provided by the platform, and often could be accessed with no additional cost.

However, it was noted that caution should be exercised when considering information provided by technology companies as it may not necessarily work in an educational context. Interrogation of the evidence base was noted to be an important factor when selecting EdTech products in the literature review (see Appendix 3), in particular, the importance of making a judgement about the credibility of any claims made by product designers. Similarly, an interviewee suggested,

> That means not going to [an EdTech show] where everyone is a salesman and everyone is trying to tell you how amazing their product is until you have bought it and then you realise it isn't fit for purpose. – *EdTech lead, Primary school*

[6] Bett or The Bett Show is a global series of education shows organised by Hyve Group marketing information technology in education.

3.1.3 Advice from EdTech partners

Schools and colleges also sought advice from trusted EdTech partners, such as IT support providers, partner EdTech companies, governors with EdTech expertise or employer partners. This included recommendations on technology to invest in and support with identifying and sourcing technology.

These trusted partners were felt to bring essential expertise to the decision making process and helped schools and colleges to ensure that the technology they implemented met their needs and had longevity.

> It's about making sure that what we're doing isn't ad hoc and that we're taking advice from a leading expert, so we're not buying the wrong kit, wrong software. And they can advise us so that we don't become outdated too quickly. – *Senior leader, GFE college*

3.2 Collaborative decision making

Collaborative decision making was important for ensuring that decisions on implementing new technology were robust and fully considered the needs of staff and learners across the school or trust.

> No one individual holds all of the answers in this space, it is very much a collaboration and a partnership, and learning and listening to the schools about what their requirements are. – *EdTech lead, Large mixed phase MAT*

Typically, decisions about EdTech involved senior leadership such as the Headteacher and the EdTech lead as a minimum, but could also include collaboration with middle leaders such as heads of department or heads of year. In one very small primary school the Headteacher was the final decision maker, although they worked with all of their staff to identify and trial tools for suitability. The EdTech lead at another small primary school collaborated with their chair of governors, who worked in the industry, to identify technology that may meet their needs before discussing it with their SLT.

Other settings had appointed a team of staff with responsibility for making decisions about EdTech at either a school, trust or cluster-wide level:

- A primary school in a large mixed-phase MAT had a network of EdTech leaders across all of the schools within the trust whose role was to drive EdTech development and implementation. The school was also in the process of developing another team of school senior leaders that would sit above the network and have a more strategic role representing their region.

- A large LA secondary school had established a ‘Teaching and Learning Forum’, which was a team of 6 teaching and learning ambassadors chaired by Assistant Headteachers and including other staff such as middle leaders and teachers who were recognised as being open to new initiatives. This team was tasked with exploring different types of EdTech to support decisions around technology implementation.
- A small secondary school in a MAT had a small team of staff with responsibility for making decisions and negotiating contracts for EdTech, as well as implementation planning and training.
- Two of the colleges interviewed had created an EdTech team whose role was to source, test and develop technology to be used in their setting.

The importance of collaboration when making decisions about implementing technology was highlighted by a middle leader at a small secondary school that had opened just 18 months prior to being interviewed:

> Because last year I was the only maths teacher, I didn’t trial anything because I didn’t have anyone to bounce ideas off. I had already planned for who I would like to work with me in the second year, someone I have worked with before, and she luckily got the job. So for this year, we can take more risks because we can both trial things and both feedback, whereas it’s hard to reflect when you are on your own. – *Middle leader, Secondary school*

3.3 Factors considered when deciding to implement new technology

Schools and colleges described a range of factors that they considered when deciding to implement new technology. The majority of these factors fell into four broad categories:

- Meeting needs - whether the technology would meet the needs of the school or college was the primary factor considered by all schools and colleges when deciding to implement new technology. A clear understanding of the needs and goals that underpinned the introduction of technology was therefore paramount for effective decision making. It was important that new technology provided an additional benefit for teaching and learning over and above what was already taking place.

  > What impact does it have on the pupils’ life within the school? Does it make their education a more memorable experience, are they going to be more engaged in their learning, are they going to make greater progress in their subjects? Does it enhance what is going on or is

> that bit better done with a pencil and piece of graph paper? – *Senior leader, Secondary school*

- Infrastructure - including integration or alignment with systems already in place and the capability of the infrastructure to support new technology (see section 5).
- Accessibility and ease of use - including consideration of staff levels of confidence and skills and whether technology was intuitive and suitable for use across different learner year groups or abilities, particularly for primary schools. Ease of use was also linked to considerations around the amount of training that would be needed to support implementation.
- The cost of implementing technology - or the budget available for investment. Software licence costs were a particular consideration as they represented a potentially large, ongoing cost if licences had to be purchased for every user and renewed annually. Maximising the use of free tools was mentioned, particularly software, websites or apps to support teaching and learning. Where schools had chosen one platform to use, free tools included with the platform were considered first, before looking more widely. The cycle of renewal for technology was also mentioned.

Other factors mentioned by individual schools and colleges included:

- Provision of support (upfront and ongoing) from the technology supplier.
- The level of expertise of the technology supplier.
- Learner and parent voice.
- Safeguarding considerations.

3.4 Use of frameworks

Seven of the schools and colleges interviewed mentioned examples of frameworks used to support them in their decision making and the implementation of EdTech. Where used, frameworks were believed to be important for ensuring the process of EdTech strategy development and transformation was fully thought through.

> You need to use some sort of digital transformation framework to move forward at a whole school level. It's not just about the tech, but the environment and processes. […] You have got to [use a framework] as it forces you to reflect and consider some areas you might not naturally think about. – *Senior leader, Secondary school*

Strengths, weaknesses, opportunities, threats (SWOT) analysis[7] and British Educational Communications and Technology Agency (BECTA)[8] dimensions of change

A secondary school utilised SWOT analysis to support their decisions to implement a teaching and learning tool (see case study 1, section 3.6). This analysis, alongside the findings from a pilot of both tools, allowed them to make a clear decision about which tool they should proceed with.

Once they had chosen the tool that would best meet their needs they used BECTA's self-review framework to support their implementation processes. This involved a number of key steps:

1. Vision - communicating the reasons for introducing the technology to secure staff buy-in.
2. Resources - ensuring the infrastructure is in place (e.g. devices, Wi-Fi, software installed, logins set up, etc.) so that the technology will work.
3. Launch - introduce to staff with upfront training on the necessary basics and quick-wins for use.
4. Roll-out - gradually introduce new features over time and training to support pedagogy.
5. Support - provide accessible ongoing training, support and resources which facilitate refreshing and expanding of staff skills.

The National Association for Education Technology (NAACE) self-review framework[9] and cost-benefit analysis[10]

A secondary school in a mixed phase MAT used an adapted version of the NAACE self review framework to support their review of EdTech use. All schools within the MAT used the same process to identify their strengths and weaknesses and the EdTech lead developed a five-year EdTech strategy linked to the schools' improvement plans. Cost-benefit analysis was used when making decisions about the implementation of one-to-

[7] SWOT (strengths, weaknesses, opportunities, and threats) analysis is a framework used to develop strategic planning and decision making. SWOT analysis assesses internal and external factors, as well as current and future potential.
[8] BECTA was a non-departmental public body funded by the Department for Education and its predecessor departments, in the United Kingdom. BECTA closed in 2011.
[9] https://repository.excellencegateway.org.uk/ACCESSIBLE_TOOLKIT-DEVELOPING_LEARNER_STAFF_PARTNERSHIPS_TO_ENHANCE_DIGITAL_CAPABILITIES.pdf
[10] A cost-benefit analysis (CBA) is the process of comparing the projected or estimated costs and benefits (or opportunities) associated with a decision to determine whether it makes sense from a business perspective.

one devices in the school. The analysis was used to help them decide between different device options to pilot.

Microsoft Education Transformation Framework[11] and Education Endowment Foundation (EEF) implementation guidance[12]

A local authority maintained secondary school used the Microsoft Education Transformation Framework to support the development of their digital strategy. Implementation guidance developed for schools by EEF was also used to support implementation of technology in the school using an approach of piloting before deciding whether to fully implement and then evaluating the impact of the technology (see case study 4, section 5.8). A key feature of the model was employing a test group and comparative control group when trialling new EdTech.

Education and Training Foundation (ETF) Digital Teaching Professional Framework[13]

A GFE college used the ETF Digital Teaching Professional Framework to support the implementation and embedding of a communication platform to be used by staff and learners throughout the college. The training provided for staff was mapped against the framework's three competency levels (exploring, adopting, leading) to ensure staff could use the platform quickly and to help the college to fully embed its use.

Rapid application development[14]

A secondary school within a large MAT used the rapid application development approach for trialling and implementing a tool for producing dynamic, one click reports on MIS and behavioural data (see case study 6, section 9.6). The process involved repeated cycles of development, testing and feedback, adapting the software programming with each cycle to develop bespoke reports for different departments within the school.

Digital Integration Partnership (DIP) process & 5T model

One large mixed-phase MAT had developed their own frameworks for identifying needs and implementing EdTech across the schools in their trust. This included:

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[11] The Microsoft Education Transformation Framework is a guide for education leaders to support them with school transformation and developing a strategy to achieve it. https://edujourney.microsoft.com/k-12/etf-k12/

[12] The EEF guidance 'Putting Evidence to Work – A School's Guide to Implementation' aims to support schools with the professional practice of implementation. https://educationendowmentfoundation.org.uk/education-evidence/guidance-reports/implementation

[13] The Digital Teaching Professional Framework is a competency framework for teaching and training practitioners in the FE and Training sector https://www.et-foundation.co.uk/wp-content/uploads/2018/11/181101-RGB-Spreads-ETF-Digital-Teaching-Professional-Framework-Full-v2.pdf

[14] Rapid application development (RAD) refers to adaptive software development approaches, and the name for James Martin's method of rapid development.

- A Digital Integration Partnership meeting held every six months between the SLT of each school and an EdTech network leader from the trust which fosters collaboration and a partnership approach between the trust and the schools. The overarching strategy and aims of the trust is linked with the top five priorities of the school. From this, a digital partnership target is created and a plan to deliver on the agreed targets.
- A five stage model (Trigger, Test and Trial, Trust, Train, Track) to identify needs, test new technology and make decisions on implementation (see case study 3, section 5.7).

3.5 Summary of what works for informed decision making

- Utilising multiple sources of information, including recommendations from education professionals and trusted EdTech partners, seeing how technology works in an educational setting.
- Scrutiny of the evidence base from technology providers.
- Collaborative decision making to support effective reflection and decision making, including senior leadership, EdTech leads or champions and wider staff.
- Use of frameworks to support thorough decision making and implementation processes.
- Consideration of whether the technology meets the needs of staff and / or learners, integration or alignment with infrastructure already in place, infrastructure capabilities, ease of use, and costs / budgets (including ongoing maintenance / renewal costs and maximising the use of free tools).

3.6 Case study 1: Selecting technology - fitness for purpose

At Cramlington Learning Village, leaders adopt an approach of identifying needs that educational technology can address. For learning, this is underpinned by a vision for how such technology impacts positively on learners' daily learning experience. Overall, the secondary school had reached a point where technology was perceived to have many strengths: its infrastructure was good with efficient Wi-Fi, learners had access to individual devices and teachers used presentational software to support learning. However, leaders thought that technology should offer learners a more interactive learning environment, both in the classroom and at home, and that it should provide teachers with greater feedback from learning activities to support assessment.

Initially, leaders considered whether there was any existing software the school had that would meet these needs. As this was not the case, they then considered whether a

solution might be developed in-house, alongside investigating commercial software that would meet their requirements. Companies were invited to provide product demonstrations and time was invested in contacting schools that were using these products to establish how they were being used and what their experiences were of their value and impact. This phase then fed into a Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis, carried out by senior leaders, which led to the identification of two commercial software products.

Next a small team of senior staff, including the assistant headteacher responsible for educational technology, commenced trialling of these two products in lessons with a small group of learners for a few weeks. This resulted in the selection of one product that would best fulfil the interactivity and assessment needs due to its additional tools. However, more functionality compared to its rival also meant it was more expensive, which might affect financial sustainability. This led to a robust cost-benefit discussion between senior leaders, with the final decision being that the value these tools offered in terms of the learning needs identified were worth the additional cost.

Further trialling of the product then occurred over three weeks by staff from two departments. Evaluations considered factors such as how easy to implement the software would be and how straightforward it would be for staff to understand. But, throughout the process, fitness for purpose (improving interactive learning and assessment) was the central focus for review, reflecting key questions posed by leaders:

> What are we trying to achieve and why, and is this tool going to help us achieve these aims? – *Senior leader, Secondary school*

4. Piloting or trialling EdTech

This section describes how schools and colleges successfully pilot[15] new technology before full implementation, including the steps taken, the staff involved and success factors.

4.1 Approaches to piloting EdTech

Piloting supported schools and colleges to make informed decisions about implementing new technology. It helped them to identify the effectiveness and impact of the technology as well as potential problems, gaps in functionality or infrastructure and challenges or pitfalls with the implementation process ahead of roll-out.

All the schools and colleges interviewed mentioned that they do pilot new technology before implementation, although this did not necessarily happen for every piece of new technology introduced. In some cases, a pilot was not felt to be necessary, particularly for teaching and learning software, websites or apps which were very accessible and easy to use, only being implemented in specific subjects, classes or year groups, or where the technology needed to be rolled out quickly. For schools within MATs, implementation could sometimes proceed without the need for a pilot where the technology had already been successfully implemented or trialled in another school within the trust.

Approaches to piloting new technology were the same as those used during implementation, but typically on a smaller scale (more detail can be found in section 5). Frameworks were used by some settings to guide and support the piloting process (see section 3.4).

The specifics of piloting varied across the schools and colleges interviewed, although broadly they followed similar steps:

- Initial testing of technology - to ‘see how it worked’ and gauge whether the technology could be suitable before deciding whether to conduct a pilot, or to move straight to implementation. Typically, this step was undertaken by senior leadership, the EdTech lead or an EdTech team and could be followed by further testing with a wider range of staff. Initial testing by teaching staff occurred where they had identified a teaching and learning app or website which might support learners in their subject, class or year group.
- Pilot planning - outlining the step-by-step process the pilot will follow, including the pilot objectives (linked back to the original needs / goals), roles and responsibilities, timings, any training required and feedback mechanisms.

[15] Throughout this section, ‘pilot’ is used to refer to a pilot or trial of new technology.

- User testing - with a sub-group of staff and / or learners such as specific classes, year groups or subjects. Piloting could be phased, with the technology firstly piloted with a small group of staff and / or learners and if deemed successful, or if more evidence was required, the technology would be tested further with other groups.
- Review or evaluation of the pilot - an essential step to ensure that decisions about whether to proceed with implementation of technology and how to best execute the implementation process, were fully informed. This review would include assessment of the experience of implementation and use of the technology, any impact or benefits and consideration of the practicalities of scaling up the implementation and use of the technology across the setting or trust.

The timescales for piloting varied. Less complex or costly technology may be piloted for a short period of time, typically a few weeks or months. Where technology was more complex, used across all subjects, had greater cost implications or where impact on learner progress needed to be evidenced, the pilot would last several terms or a whole academic year. Cyclical piloting involving a repeated process of in-development testing and feedback was also conducted over longer time periods to allow for adaptations to be made and reviewed.

Practice example – the importance of conducting a thorough pilot evaluation

The importance of thoroughly evaluating any pilot was highlighted by a primary school that piloted the implementation of an E-Reader in one key stage 2 class, prior to roll-out. They had hoped that using E-readers for all learners would increase independent reading, save money and space for storage of books, allow equal access to material, and reduce cost for replenishment due to physical wear and tear.

The pilot was deemed successful, but implementation failed on roll-out because they had not thoroughly analysed the pilot in terms of considering management of the devices when scaling up from one class to whole school use. For example, considering: how and where the devices would be charged, creating email addresses for every child in the school, simplification of the logging on process and password management for a key stage 1 context, how devices could be linked so that books could be shared across the entire year group, and how learners could be prevented from accessing and downloading material independently without the teacher's knowledge.

Following unsuccessful roll-out across the school, the devices had to be withdrawn and were eventually sold at Parents, Teachers and Friends Association (PTFA) events to try and recoup some of the financial outlay. As a result, the school's EdTech policy was rewritten to include detailed questions (such as, how easy is it to manage a device?), that need to be analysed at the point of evaluating a pilot.

4.2 Piloting success factors

The success factors for conducting a pilot of new technology were very similar to those for implementation (see section 5). Factors specific to piloting included:

- Including a range of skills and confidence of the staff and / or learners testing the technology - as this can affect the outcomes of a pilot. For example, testing with more skilled and confident users would be more likely result in a more positive pilot outcome but unforeseen challenges may arise when the technology is rolled out more widely.
- Utilising a 'test' and 'control' group approach - where one group tests the use of the new technology (test) and another group does not use the technology, or uses an alternative approach (control) so that comparisons can be made. This approach was felt to provide rich feedback and robust evidence on impact so that decisions could be made with confidence.
- Ring-fencing time - to ensure staff have sufficient time within their day to explore and pilot new technology, such as allocating specific time each week to plan, prepare, and evaluate new technology, and supporting other staff using the technology.
- Reflecting on the lessons learned from a pilot - was noted as an important factor for future success, whether that be future pilots, or implementation roll-out. As part of this reflection process, one school felt it was important to acknowledge when things did not work and to have a culture where staff were encouraged to try out technology to see if it works, or not.

> We are really keen for staff to try things and, give them permission to make mistakes, I suppose. As a culture what we try to embed in the children and the staff is to try things and it maybe it won't work, maybe it will, it is a learning process. […] Only by trying in lessons will you be able to see if it is an amazing tool or not quite for you. – *Senior leader, Primary school*

4.3 Summary of what works for piloting new technology

- Initial testing to assess functionality and suitability.
- Effective planning of the pilot to support more informed decision making.
- User testing, including a range of skills and confidence of the staff and / or learners testing the technology utilising a 'test' and 'control' group approach.
- Ring-fencing time to explore and pilot new technology.

- Review and evaluation of the pilot, including experience of implementation and use of the technology, impact or benefits, consideration of the practicalities of scaling up use of the technology, and reflecting on lessons learned.

4.4 Case study 2: The value of piloting for successful implementation

One element of Denbigh High School's technological vision was for learners to have access to one-to-one devices for learning. As part of achieving this, seven one-to-one technology schemes were reviewed with cost-benefit analyses applied to arrive at one preferred option. The selected devices were then subject to a one-year piloting scheme. This sought to gather evidence of impact which could be presented to staff, parents and carers with a view to supporting future roll-out. Such roll-out would need their buy-in, in terms of understanding and supporting its purposes and, in the case of many parents/carers, their financial contribution. Piloting also provided opportunity to test out safeguarding aspects of the technology such as monitoring what was being accessed, with the Designated Safeguarding Lead involved in this aspect.

The pilot was carried out with a middle-attaining group of 28 year 7 learners. This group was chosen for a few key reasons:

- First, it was anticipated that should the technology be piloted with higher-attaining year 7 learners, they would be more likely to experience success and the school wished to gain a more representative picture of how learners would manage.
- Second, there were two other groups of middle-attaining year 7 learners who could act as control groups (who did not have personal devices and therefore, whose learning outcomes could be compared with those of the pilot group).

All the learners took their devices with them to every lesson and 13 teachers were involved in piloting with this group. These teachers, for example, fed back to senior leaders on roll-out considerations such as usability and staff confidence levels needed to use it, as well as how effective it would be in reducing workload and enhancing learner engagement.

Evaluation of impact reflected what the Technology for Learning Lead described as a 'transformational' effect. This was noted in the depth and breadth of learning between the pilot group and the other two control groups. Pilot group learners' learning was much more comprehensive, covering greater lesson content in less time enabling more extension work to be provided. They were writing more as well as being more adventurous with their use of language and boys' engagement was much better. The pilot therefore, provided a bank of evidence on the benefits of device use, the blended

approach to learning and the safeguarding aspects to communicate to parents/carers and staff.

5. EdTech implementation process

This section of the report details the key processes that schools and colleges went through in implementing and embedding EdTech. It draws out in particular what has worked for schools and colleges when planning for and then rolling out technology.

5.1 Schools' and colleges' approaches to implementation

A range of EdTech had been implemented across the schools and colleges involved in the research. This ranged from EdTech that had been implemented at a whole school / college level (for example, management information systems, collaborative online platforms and one-to-one devices for learners), to EdTech that has been introduced for a specific teaching and learning function (for example, a formative assessment tool), or only in a specific subject area (for example, maths software). Other schools and colleges interviewed spoke more generally about multiple types of EdTech that had been introduced.

The research identified examples of phased roll-out and full implementation across a school / college or MAT. Schools and colleges that had rolled out EdTech fully from the outset had done so mainly because of the need to use the EdTech promptly within the setting. Most commonly this was where EdTech had being introduced to support remote education provision in response to the COVID-19 pandemic. Another school mentioned that they had rolled out some teaching and learning software to the whole school at the same time because all staff were on board with the use of the software and therefore they felt comfortable with a full roll-out. A phased implementation was also mentioned, for example, where the infrastructure was not able to support concurrent school-wide roll-out or whether the school or college had taken a strategic decision to embed the technology in a certain area (such as department or subject) before rolling out further.

However, what was common across all schools and colleges participating in the research, was how integral training and support was to successful implementation of technology. Further detail about the approaches that schools and colleges had taken to training and support can be found in section 6.

The stages that schools and colleges went through when implementing EdTech included:

- Planning for implementation.
- Assessing and preparing the infrastructure.
- Driving, encouraging and supporting use.
- Streamlined integration.

5.2 Planning for implementation

In the process of planning for implementation (either with or without having conducted a pilot), it was important for schools and colleges to reflect on their journey so far, including the purpose, intended outcomes and benefits of the technology, before deciding on the best approach to roll-out. This aligns with the findings of the literature review (see Appendix 3), which noted that conducting a preliminary impact assessment of an EdTech product allows for a structured process to consider the implications of implementing an EdTech product before purchasing or implementing it.

Key planning steps and considerations that schools and colleges went through included:

- Reviewing the pilot data (if undertaken) - or other pre-implementation feedback, to identify whether the technology showed the intended improvements (for example in teaching and learning). This helped to shape the focus the wider roll-out, and identify any problems or needs to address prior to further implementation.
- Having a clear timeline and plan for roll-out - a number of schools and colleges mentioned developing an action plan for implementation, including staff responsibilities and the timing for implementation. Schools and colleges thought it was important to consider within this:
    - How and where the EdTech was to be implemented (at a whole school or college level or on a smaller scale, for example, in one year group or with one year group of learners).
    - The timing for EdTech implementation within the academic year (for example, avoiding times which may impact on staff workload, or which are pinch points, such as, exam periods).
    - How the success of implementation is to be measured, what evaluation approaches will be used and how impact will be measured.
- Agreeing and setting expectations for use - being clear from the outset about how EdTech was going to be used in practice and the expectations on staff for use, including:
    - Clear guidance on how the technology should be used and how this may differ for different users (across departments, key stages, and subjects). For example, when introducing new teaching and learning software, setting expectations for when and how teachers and learners should use the software was important.

    > We had set the expectation of how often we would expect it to be used. For the older children in key stage 2, they would use it a lot more than they did in key stage 1 for example. Again, that is based on the competency level of the children. We want to make sure the

> children are engaged in the lessons that they are doing and also it impacts on their learning. Expectations were set through staff meetings. I explained to the staff what I had been doing and what I used it for. Then collectively we came up with an idea of what we thought was appropriate really. Everyone had a role in inputting before we rolled out not everyone is as confident as others. – *Senior leader, Primary MAT*

- Flexibility and autonomy (if possible) - to decide how to use the EdTech within their practice. For example, giving staff the opportunity to use the EdTech for different tasks (although this may vary dependent on the technology that is introduced).
- Recognition that some staff may be more willing to adapt to and use EdTech much quicker than others, and therefore, both the approach to implementation and the expectations around use should reflect that difference and have some inbuilt flexibility.

5.3 Assessing and preparing the infrastructure

Schools and colleges involved in the research said that it was important to consider whether the infrastructure was sufficient to support any new technology being implemented, such as device numbers or capacity, Wi-Fi or internet limitations, cloud capacity or system security. Ensuring that infrastructure met the standards necessary was cited as an important first step before any implementation could take place. This was deemed to be particularly important where new whole-school / college systems were being introduced, or where the volume of technology to be introduced (such as one-to-one devices for all learners) would have a significant impact on existing technology infrastructure or wider practices. However, even for the introduction of smaller scale technology, consideration of its impact on the existing infrastructure prior to roll-out was important as it helped to establish whether any changes or improvements needed to be made.

> Before you invest in anything, does your network work, does your Wi-Fi work, what is your cyber security like? You need to ensure everything in the background is secure. – *Senior leader, Primary school*

Examples of where schools and colleges had found this to work well included:

- Undertaking an infrastructure audit to assess the suitability of current technology and whether there would be any improvements needed to support EdTech

implementation. For example, a primary school interviewed found that their Wi-Fi capabilities were not sufficient to support the introduction of one-to-one hardware devices for each learner and they had to invest in enhancing their Wi-Fi capabilities before roll-out.

- Allowing sufficient time within the planning stage for the EdTech to be fully tested by technical staff, allowing any issues or challenges to be resolved prior to roll-out.
- Addressing the practicalities of implementing EdTech and how learners and staff would access it (particularly for teaching and learning focused EdTech). For example, the logistics of setting up log-ins for learners to access a teaching and learning platform.
- Considering how new EdTech systems could be integrated with existing systems. For example, one school interviewed had to address how they could move their existing data from a school management system onto their new cloud-based system.
- Pre-empting and responding to potential challenges of EdTech being able to be accessed outside of the school or college. For example, whether and how staff, learner and parents/carers (if necessary) would gain remote access.

Practice Example – Importance of considering access for all learners

A large tertiary college which moved assessment to digital platforms, found on roll-out that whist a large proportion of learners had adapted to the EdTech changes, some learners with special educational needs and disabilities (SEND) and foundation studies learners had been unable to access the platforms. For example, some had difficulties logging in due to co-ordination difficulties, or they were not able to transcribe a six-digit number for multifactor authentication from their mobile phones onto the computer log-in page.

In response to this, the college have trained parents, carers and support workers to be involved in the process for the learners. However, they recognised that this has an impact on the learners' independence.

5.4 Driving, encouraging and supporting use

The literature review (see Appendix 3) identified teachers' attitudes as a key barrier to EdTech take-up and implementation, highlighting the importance of user engagement in EdTech implementation. Feedback from the interviews echoed these findings.

Engaging users (staff, parents/carers and learners) in the implementation of technology was seen as a pivotal factor in ensuring that it was implemented well and used effectively so that users felt they had the skills, confidence and capability to use it. Bringing staff and

users (such as parents/carers and learners) on board throughout implementation had been a focus for most schools and colleges involved in the research. Whilst training and support (see section 6) was central to user engagement, having strong communication and the engagement and commitment of senior leadership was also considered to be critical in supporting successful EdTech implementation.

5.4.1 Communicating the vision and approach for EdTech

The establishment of effective communication strategies and messaging around the implementation of EdTech was seen as fundamental to bringing users on board with implementation and helping to secure buy-in. Schools and colleges used varying communication methods (ranging from face-to-face, to remote). Successful approaches to communication around EdTech implementation included:

- Being clear on the purpose and rationale for introducing technology - clarifying what the introduction of new technology is aiming to achieve for staff and learners and using clear and transparent messaging. This helped alleviate staff and learner reluctance or concerns. For example, the messaging might include explaining the benefits to learning (such as increased independence or improved skills).
- Communicating with staff at all levels (as necessary) to support staff engagement - for example, middle managers cascade messages down from SLT to reinforce messages about EdTech implementation with their staff.
- Direct communication with parents/carers and learners - about EdTech implementation if they would be directly affected (for example, if a new communication technology is being introduced).
- Using multiple communication approaches - with consistent messaging, to help reinforce messages.
- Raising the profile of the EdTech implementation at a school or college level - for example through promotion (posters, promotion on website, internal system/intranet).

> You have got to get people's buy-in. You have to explain to them the benefits, and one that unifies academic staff is if you can demonstrate or if you can provide a sound rationale, about how introducing technology is going to improve things for learners. – *Senior leader, GFE college*

5.4.2 Senior leadership engagement and commitment

The role of senior leadership within schools and colleges was highlighted as being integral to developing and leading the vision for EdTech. At an implementation level,

schools and colleges felt that SLT played an important role in driving forward the use of EdTech. Successful approaches included:

- Ongoing dialogue between SLT and staff about EdTech implementation, for example updating them on progress, or successful approaches.
- Demonstrating a willingness at a senior level to adapt their own practices to adopt new technology. For example, a college that had moved to an online platform for remote teaching reported that their SLT had been willing to adapt to using the technology quickly. SLT had promptly moved observations online and had made themselves available to do the observations, which helped secure wider use and engagement.
- Being prepared to dedicate resources to driving forward EdTech implementation including finance and staffing. For example, being willing to invest in the infrastructure to support EdTech implementation (such as upgrading the Wi-Fi).
- Allocating appropriate staff (such as digital leaders, EdTech leads) to drive roll-out forwards, to provide appropriate training and support for users, and to be the link between users and SLT.
- Having conviction in the decision that had been made to implement the EdTech. Remaining focused on the purpose and rationale for introducing technology, being consistent and not deciding to dilute the approach or change course if problems are faced.

Practice Example – Demonstrating senior leadership engagement

A GFE college, which had experienced significant staff resistance to using a new piece of software, decided to use a member of the leadership team to trial new EdTech software with one of the departments in their curriculum area. They were then able to roll this out to the other departments in their care more successfully. The leadership team line manager was able to share data on positive impact, and also had the authority to encourage implementation and embedding of the technology. Senior leadership buy-in ensured that EdTech was represented at board level and had the same level of importance as other aspects of college management.

> I report on (EdTech implementation) at a senior level, and that really makes a difference. EdTech becomes part of the college quality assurance process, the development plan, and that makes a big difference. Without that, having sufficient credence to drive (EdTech) forwards is very difficult to do. – *EdTech lead, GFE college*

5.5 Streamlined integration

Schools and colleges integrated EdTech within wider systems to further embed its use and support alignment with other mechanisms and processes. This also helped to demonstrate the priority that the school or college placed on EdTech, normalising its use and encouraging staff to engage with the longer-term EdTech vision. Examples of where schools and colleges integrated EdTech at a wider level included:

- Aligning the EdTech used (for example a virtual reality headset in a vocational subject in a college) with the qualification assessment criteria.
- Integrating EdTech into teaching and learning and school systems. For example, integrating EdTech within curriculum design, schemes of work or curriculum maps.

> Seeing it as a priority is really important, we talk about that a lot. Seeing how it can enhance other learning really helps to embed it in the curriculum. If technology is seen as being isolated from other subjects then it is harder to embed as a culture. […] That's why we stopped having separate computing lessons, because by keeping it separated you are never going to embed it. You have to make sure it can feed into every area of the curriculum. – *Senior leader, Primary LA maintained school*

- Changing existing school policies to align with the EdTech that has been introduced. For example, changing the marking policy from green/red pen to the use of digital tools (such as, through collaborative platforms or the use of audio notes).
- Integrating discussion on EdTech use into line management or performance development reviews to ensure it is on the agenda.

Practice Example – Integrating EdTech

This local-authority maintained secondary school introduced a piece of teaching and learning software which acts as an electronic exercise book, allowing teachers to view and comment on learners' live work (including audio verbal feedback), and embed video and audio resources. The software is now fully embedded in teaching practices and wider school systems. For example, the software has been integrated into staff quality assurance processes, including departmental improvement plans.

The school leaders have set expectations about curriculum design across the school (at least 25% of the curriculum must show EdTech use) and therefore, the software is now well embedded within schemes of work across various departments.

5.6 Summary of what works when implementing and rolling out technology

Key success factors in the roll-out process were:

- Reviewing the pilot data, having a clear timeline and plan for roll-out, agreeing and setting expectations for use and in-built flexibility.
- Assessing and preparing the infrastructure for implementation by:
    - Undertaking an infrastructure audit to assess the suitability of current technology.
    - Allowing sufficient time for technical testing to resolve any issues.
    - Considering the practicalities of users accessing the EdTech (for example, setting up log-ins in advance).
- Driving, encouraging and supporting user engagement with EdTech through:
    - Communicating the vision and approach for EdTech.
    - Senior leadership engagement and commitment.
    - Communicating the vision and approach for EdTech across all users (staff, learners and parents/carers), including the rationale for introducing technology and its purpose.
    - Demonstrating senior leadership engagement and commitment through dedicating sufficient resources to drive forward implementation, including allocating appropriate staff (such as digital leaders across departments or teams) to drive forward roll-out, and provide appropriate training and support.
- Streamlining and integrating EdTech with wider systems to normalise use and encourage engagement with longer-term EdTech vision.

5.7 Case study 3: Using a five-stage model of EdTech implementation

Academies Enterprise Trust adopts a strategy combining centralised use of EdTech across the MAT in key areas alongside its use to support individual schools' needs. The latter of these is supported by bi-annual partnership meetings between central EdTech team representatives and individual school leaders to understand school improvement priorities and discuss how EdTech can support their achievement. The MAT has also adopted a five-stage approach to implementing EdTech as set out below.

This approach was used in the case of one secondary school's music department using expensive composition software only available to learners on ageing hardware. Working through the five stages, a partnership meeting explored the issue, identifying with the music teacher what cloud-based applications could deliver the same requirements. A cloud-based alternative was identified and made available in both the music classroom by repurposing the ageing hardware with a cloud operating system and also on one-to-one devices that had recently been introduced MAT-wide. The impact was positive as it was available at any time, the classroom devices ran more quickly, and access was less costly and more controllable because the application was subscription-based.

The five-stage model.

- Trigger: A request is made via an online form to trigger a test, for example, of a cloud-based tool. This might be based on a need (of one or more schools, or a MAT-wide need), or could be a piece of EdTech that is considered as potentially beneficial to use.
- Test: The request is considered by a team of technology leads (teachers with technology expertise in schools across the MAT) and one or more will take responsibility for exploring options. The selected technology will be tested initially if required, for example with a small group of teachers representing a range of technology capabilities, and their learners. This might be within one or more schools and outcomes will be reviewed to determine whether to conduct a larger scale trial.
- Trial: If the tested EdTech is considered to be of sufficient value, it will be supported as recommended technology and made available at a MAT level. This can lead to wider roll-out, subject to MAT procurement processes.
- Train: Once recommended, training is provided by the MAT technology leads and/or external companies for staff and learners.
- Track: Finally, the implementation, embedding and impact of the EdTech is monitored and evaluated via the bi-annual partnership meetings.

5.8 Case Study 4: Two approaches to implementation

Example 1: At Ribblesdale High School, both staff and learners supported the implementation of electronic exercise books for use across the curriculum, as part of a blended learning strategy.

Staff digital leads (DLs) were central to driving implementation forward. Initially, a small team of DLs were appointed from three departments and given some dedicated time per week to plan for piloting the software's use in their own classrooms. This drew on the Education Endowment Foundation's (2018) Implementation Guidance in using control group comparisons. For example, in some lessons, DLs used the technology with one class but not with another parallel class to gain feedback on perceived impact. Pilot outcomes on what worked well and what might be better were subsequently shared in the Teaching and Learning Group to support thinking about next steps. The team of DLs was then extended so that there was one within each department to explore how they might use the technology to suit the department's needs and their learners' learning needs. The DL role has since shifted to one that supports embedding of practice and the integration of EdTech in teaching and learning so that the focus is on how technology is integral to supporting good teaching and learning rather than being an entity its own right.

The school also used a scheme of learner digital helpers who applied for the role and were trained on how to use the software to support teachers should they not be so technically adept and needed in-lesson support. This helped address some teachers' concerns about 'not being the expert on tech'.

Example 2: In Weston College, three teams were used to support EdTech implementation in their introduction of virtual reality (VR) software. Their roles were integrated into key phases of the college's staged implementation strategy[16].

- Exploring phase - in one case, specialist content developers worked with curriculum staff to develop VR specifically targeted at a personalised learner workplace experience and piloting of this.
- Specification stage - the IT team ensured the EdTech meets demands prior to purchase, for example, ensuring cyber security expectations were met and that it was compatible with the college's infrastructure.
- Technical testing and implementation phase - the technology team tested functionality in the learning space and, where required, liaised with the IT team to

[16] These comprise: SLT consideration, exploring, specification, procurement, technical implementation, curriculum use with staff training, ensuring firmware updates and cyber security protocols, QA team review of impact.

ensure the technology was working as intended. The technology team then provided training and support to ensure staff and learner competence in its use.

- Quality assurance (QA) phase – the QA team reviews impact through QA processes such as lesson observations and deep dives, and provides pedagogic guidance where needed to ensure that the technology effectively supports learning.

6. Training and support

This section details the types of training and support offered by schools and colleges to support the successful implementation of EdTech. It also details key success factors highlighted by schools and colleges.

6.1 Types of training and support offered

The provision of training and support was a key feature of schools' and colleges' approaches to the successful implementation of EdTech and spanned all stages of the process (piloting, roll-out and embedding). Schools and colleges were often delivering upfront training on EdTech, alongside further ongoing training and support during and post-implementation.

The training and support models used were driven by the scale and focus of the EdTech that was being introduced. For example, the adoption of new whole school or college wide systems was likely to be accompanied by more intensive and sustained training and support. The introduction of smaller-scale EdTech (such as a teaching and learning app for a specific subject), would still have associated training and support, but perhaps to a lesser extent. For example, support may be provided through department or curriculum meetings.

The target audience for training and support also reflected the type of EdTech being implemented. Teaching staff were often a key focus of the training and support provided, reflecting that for a considerable amount of the EdTech implementation covered in this research, they were primary users. Schools and colleges also spoke of undertaking specific training with other staff (such as support or administration staff), learners and parents/carers, although this was less common.

The staff involved in delivering training were varied, ranging from technical staff (IT technicians, IT leads, EdTech leads, e-learning advisors), senior leaders or subject specialists (such as subject leads or curriculum leads), to external support provided by EdTech companies (often those that had supplied the EdTech itself). Schools and colleges made decisions about who was best placed to deliver the training dependent on their knowledge of the EdTech being implemented.

The range of training and support activities that schools and colleges mentioned were vast, and examples of these are listed below.

- Whole-school/college approaches - whole-school launch training, induction sessions (for new staff), INSET days or formal CPD sessions to focus on training around EdTech, internal training by teaching and learning leads, workshops on how to use a teaching and learning app.

- In-classroom support - support from technical staff for teachers in the classroom on the day of launch (such as when introducing one-to-one devices) to deal with any issues, learning walks and classroom observations.
- External support - training from external companies on how to use EdTech, support from EdTech demonstrator schools, support from other schools in a MAT.
- Remote/in-direct support - online hub of resources/training and support videos, webinars, recorded training videos from live sessions held on Zoom.
- Ongoing support - refresher training, to reinforce how to use particular EdTech, using the school/college newsletter to hyperlink to key elements of the training on EdTech, TeachMeets (every two weeks) to introduce new elements of an EdTech system to staff, open door policy with IT/technical team.

6.2 Success factors in providing training and support

Schools and colleges were able to provide many examples of successful features of their training and support models. Providing flexible, and ongoing training and support was seen as critical. They thought that training and support should be reviewed on an ongoing basis in order for EdTech to continue to be used and embedded successfully.

Success factors have been themed as follows:

- A strong training and support framework.
- Considering the format of training and support.
- Making training and support meaningful to users.
- Adopting a continuous, but phased approach.

These success factors align well with those identified in the literature review (see Appendix 3) which found that the core features of effective professional development activities to support teachers' technology integration should consider content focus, active learning, learner voice and be sustained over time. They are considered in more detail below.

6.2.1 A strong training and support framework

Having a strong infrastructure in place at a school and college level helped facilitate the provision of training and support around EdTech implementation. It was reported that effective planning of the implementation process (see section 5.2 for more detail), including making the right decision about the EdTech to be implemented, robust preparation for implementation (with consideration of technical capabilities, logistics and how the EdTech was to be used), should make the need for training easier, and staff or

other users should be able to adapt to using the new technology with ease. However, schools and colleges did suggest other factors that should be considered when providing training and support around EdTech implementation. This included:

- Using in-service training (INSET) and induction days dedicated to staff and learner training (if required). This helped to establish EdTech implementation as a priority and ensured that all those expected to use the technology were trained at the same time.
- Allocating sufficient resources to providing ongoing support, such as having staff with key responsibilities (for example, EdTech leads, digital coaches, e-learning advisors) to continue to check in on how users were adapting to EdTech use and whether they required any further training or support. This included providing sufficient time (such as through dedicated CPD time, or staff meetings) to allow for training and support to be revisited and reinforced.
- Considering the need for dedicated pedagogical support, in addition to technical support (for teaching and learning focused EdTech) to reflect that teaching staff may need this type of support to know how to implement EdTech within their classroom practice. For example, a college involved in the research had established an internal, cross-college coaching team who had a role in providing pedagogical support for teaching staff.
- Using trainers with the right skills and expertise to deliver the training. Having trainers (both internal and external) that were clear, supportive and with the appropriate skills helped with user engagement. This included drawing on external support as needed or if the skills did not exist internally.

> I think the way that the EdTech lead trains people is really great, he keeps it simple and understandable. He is very patient as well which I think is really important. There were definitely lots of positives in the training. – *Teacher, Primary MAT*

6.2.2 Adopting a continuous, but phased approach

Training and support was viewed as being fundamental to the effective implementation of EdTech, however, schools and colleges recognised that this needed to be balanced with consideration of staff capacity. Adopting a continuous model of training and support was perceived to help maintain both the engagement and buy-in of staff, but also to maximise the effectiveness of the technology within the school or college. Where this had worked well for the schools and colleges involved in the research their approaches had included:

- Starting with basic training and then providing more in-depth or intensive training (for example, introductory training followed by a bootcamp) to add to users'

knowledge and understanding, such as to cover more functionality of an EdTech tool (for example, breakout rooms or polls on a teaching platform).

- Building up staff knowledge and confidence steadily by introducing new concepts gradually.

  > There needs to be very good training at the start of the implementation and it should not be rushed. You need to ensure all staff are comfortable and know what they are doing with the tech. You shouldn't build on the use too quickly until all staff have the basics mastered. – *Teacher, Secondary MAT*

- Knowing the capability of different EdTech products, what the strengths and limitations are from the outset and providing follow-up support to get feedback from users about what works, what does not work and where further training or support is needed.

Practice example – ongoing training and support

This single academy secondary school have embedded a teaching and learning platform that includes interactive lessons, videos, gamification and activities. The school provided an initial training session covering the basic functions and staff were given the opportunity to go away and try it.

The school are now using their collapsed timetable one afternoon per week (2 hours a week) to allow department staff to work together in a more dedicated way to explore how the platform could be used, which allows them to build on the initial input and consider how it could be specifically applied in each subject.

6.2.3 Consider the format of training and support

Establishing a flexible model of training and support, using varying formats allowed schools and colleges to respond to the differing levels of staff confidence and capability in the use of technology, whilst offering training and support that was manageable within an often time-poor, pressured environment.

Schools and colleges had used formats for training and support that allowed users to access the training via multiple means. The COVID-19 pandemic had led to a greater focus on remote training and support; and schools and colleges felt that some of these practices would be beneficial to continue in the longer-term. They recognised the benefits of remote training and support for both accessibility and efficiencies, whilst considering that complementary face-to-face training approaches should also feature highly.

Specific training and support formats that schools and colleges had found to work well included:

- Using remote or recorded training to support accessibility and allow staff to access the training in their own time.
- The development of bite-sized, dip-in and out training resources (such as short videos, TikTok videos, online tutorials).

> As beneficial as webinars are… teachers are stretched and don't have enough time to watch an hour webinar, and then they are given too much information and don't know where to start. *Teacher, Primary LA maintained school*

- Keeping the structure and content of training simple. For example, developing step-by-step guides including screen captures to make the instructions clear for users or only showing users one way of doing things to avoid confusion.
- Hosting all information and training guidance in one place (such as on an online collaborative platform) to ease access for staff.
- Incorporating opportunities into the training and support for role modelling (either face-to-face or virtually). For example, real-life demonstrations on how to use the technology.
- Establishing a cycle of refresher training for EdTech, particularly if it used less often (such as timetabling software).

6.2.4 Making training and support meaningful to users

Fundamental to the training and support offered around EdTech implementation was consideration of how best to engage users so that they felt equipped to use the technology (that is they have the skills they need) and have the confidence to then adopt the use of the EdTech within their practice. Schools and colleges reported that staff could sometimes be reluctant to adapt to new technology (see challenges in section 8) and therefore the approach to training and support needed to account for this.

Schools and colleges had developed approaches to training and support that considered user engagement with EdTech by:

- Building in opportunities for staff to practice using the technology, with time to come back and reflect on how they have found the experience.
- Giving teaching staff the opportunity to see technology in action. For example, through observing the technology in use in other classes internally, or in other schools who have successfully embedded the technology already.

> We've had staff go off and create and share what they have been doing. This is a really useful method, it makes it real, you can see

> applications of it in your own classroom, how to tweak it and use in your own lessons. Seeing other practitioners use it is most useful. – *Senior leader, Secondary MAT*

- Differentiating and personalising training and support to reflect users needing to apply the technology in their specific context (such as in a particular subject, or with a specific year groups/ages).
- Offering training at different levels (for example, offering basic, medium, advanced training options) that allows staff with varying levels of confidence and capabilities to access training at the level right for them, at the right time.
- Developing a peer-to-peer model of support, or a community of practice; giving staff the opportunity to share with others how they have used the technology in their practice and what has worked.
- Giving staff the opportunity to gain accreditation in the EdTech training they have received (such as in a specific hardware). This can support staffs' professional development and can help with buy-in.
- Use of learner champions. For example, a secondary school had appointed a team of learner digital leaders who were interested in technology to showcase how they were using EdTech and to support those learners who needed it.
- Showcase and recognise great teaching and learning that has been achieved through effective use of EdTech. For example, by sharing case-studies on the newsletters or in staff meetings.

> Drip-feeding of weekly training videos helped gradual upskilling, and the face-to-face provision of training helped with reluctant staff, as they liked to be in a more secure environment where they were being told what to do rather than having to be far more reliant on finding out for themselves by accessing training videos. – *Senior leader, Secondary School*

6.3 Summary of what works when training and supporting technology implementation

- A strong training and support framework including:
    - Using in-service training and induction days.
    - Allocating sufficient resources to provide ongoing support.
    - Dedicated pedagogical support alongside technical support.

    - Having trainers with the right skills and expertise to deliver training and support.
- A continuous, but phased approach to training and support considering:
    - Building up staff knowledge and confidence steadily.
    - Starting with basic training and then providing more in-depth or intensive training as required.
- Flexible models of training and support using varying formats including remote or bite-sized options, options for role-modelling and refresher training.
- Focus on engaging users through allowing time to practice, showing the technology in action and differentiating and personalising training and support.

6.4 Case Study 5: Supporting EdTech implementation - two approaches to staff training

Example 1: Short-term intensive training at Danesfield School.

As part of its digital strategy to improve teaching and learning, this primary school used weekly staff meetings across a term to develop teachers' expertise in using technology in lessons. This was led by the headteacher with the intensive investment of time seen as central to success as it focused on regular usage, building momentum in learning. Each week, training time enabled teachers to develop skills in a specific tool which would enhance learning within the planned curriculum, for example software for creating digital presentations. They were then expected to use this the following week and share what they had done at the next session, feeding back on impact and what had worked or not to disseminate key learning. Teachers with greater confidence and skills were initially allocated more advanced tools.

To support this approach, teachers were able to access free external online learning sources through which they could practise using tools and gain certification for their engagement with these. Further, they were able to observe the application of specific tools in the classrooms of those who had developed expertise, supporting their own use. Over time, this approach enabled greater expertise to become embedded across the staff.

Example 2: Long-term multi-faceted training at Cramlington Learning Village.

When implementing new software to improve lesson interactivity and provide more assessment information to teachers, this secondary school drew on the British Educational Communications and Technology Agency's (BECTA's) five Dimensions of

Change, with staff skills development being the second dimension. To develop teachers' skills, the school utilised a multi-faceted approach:

> CPD can't be one-off but needs to be provided over time and revisited, with opportunities for staff working and supporting each other. – *Senior leader, Secondary school*

- Basic skills training - which focused on key software features so use with learners had immediate impact.
- Tailored training - focusing on software to support specific pedagogies (for example, retrieval practice), sharing of effective practice, and training on additional software features (such as, targeting for specific subjects).
- Weekly staff CPD sessions - these enabled departments to explore how to apply the software to meet their specific needs, including designing lessons and sharing practice with opportunities to support those less confident.
- Digital library access - including school-prepared video tutorials designed to support understanding of specific software functions and which reinforced or extended teachers' learning dependent on confidence or need. They also enabled teachers to share their post-tutorial application of learning (for example, through uploaded presentations).
- Staff enquiry - teachers trying out new features and considering impact on learners' learning through self-reflection, interviewing learners and gaining feedback from a peer observing a lesson. From these, enquiry reports were written and shared with a number of staff groups, such as, the Teaching and Learning group, as this has representation from departments enabling further dissemination.
- Online training courses - the school is developing in-house, online certificated CPD courses, including those to support use of the software, for example, focusing on advanced users or for those wishing to use technology for assessment. Dedicated time will be given during weekly CPD sessions. They will include practical application of learning and reporting of impact of this on' learning to inform peer use.

7. Monitoring use and effectiveness

Approaches that schools and colleges adopted to monitoring the use and effectiveness of technology was influenced by the type of EdTech that had been introduced, how it had been implemented (for example, at a whole school/college level or within a particular department) and the expectations for how the technology was to be used. For example, the approach that a school would take to monitoring the use of classroom-based teaching and learning software, would be different to that taken to monitoring use of a whole-school level management information system. Schools and colleges recognised the value of utilising ongoing monitoring processes after implementing EdTech to understand:

- Whether the EdTech implemented was being used as intended.
- User perceptions of the technology.
- Whether users required further support or training.
- The benefits or impact of the technology, for example on teaching and learning provision and learner outcomes.
- The progress in embedding EdTech within the school or college.

Most schools and colleges were able to report on monitoring processes they had adopted. These processes were varied but broadly covered most of the following:

- Seeing EdTech in practice.
- Monitoring EdTech usage.
- Obtaining user feedback.

However, it was recognised that multiple monitoring processes were needed in order to gain a comprehensive and holistic understanding of how well technology was being used and embedded.

Although schools and colleges mentioned multiple approaches to monitoring the use and effectiveness of EdTech, they recognised that it was more challenging to quantitatively measure the impact of technology implementation on learner and staff outcomes (for example, on learner progress and staff workload reduction) in a robust way. However, schools and colleges did mention that they were starting to consider how they could measure outcomes using a quantitative approach. For example, a school that had introduced teaching and learning software which acted as an electronic exercise book were considering how they could measure the impact of use on learners' knowledge, retention and their use of skills across subject areas.

7.1 Seeing EdTech in practice

For EdTech introduced to support teaching and learning (such as teaching and learning apps, remote education platforms, formative assessment software), seeing how the EdTech was being used in practice was important to schools and colleges. It helped them to understand how effectively EdTech was being used within a teaching and learning environment; whether it was enhancing provision, and how learners and staff were engaging with it.

Where the monitoring of EdTech required the direct observation of teaching, approaching this in a non-threatening, non-judgemental way was deemed important. Schools and colleges had to balance the importance of evaluating how EdTech was being used in the classroom, and how teachers and learners were adapting to it, with an understanding that staff in particular felt that they were able to adapt and make mistakes as they became used to using it.

Schools and colleges mentioned both formal and informal approaches to monitoring EdTech implementation, including:

- Learning walks, classroom and teaching observations.
- Pedagogy coaching team observations and feedback.
- General assessment within lessons, making sure learners can use EdTech effectively and independently and that it is supporting their learning.
- Work scrutiny to establish whether there was any evidence that EdTech was enhancing provision and outcomes.

7.2 Monitoring EdTech usage

Schools and colleges were using data on engagement with EdTech to understand whether the technology was being used to the extent that was expected. Usage data was also viewed as being a proxy measurement for understanding how users were engaging with the technology, which also helped to identify where there were weaknesses, areas for improvement, where further support may be needed for staff or whether the level of usage reflected a good return on investment.

Usage data from the technology was not generally looked at in isolation, with schools and colleges instead looking at this data alongside the collection of wider information (for example, informal and formal feedback from users) to provide a more rounded view on how the EdTech had been adopted and used.

Schools and colleges gave examples of monitoring:

- Frequency of use, how often, for example, a teaching and learning app was being used (for example through monitoring log-ins, how usage differs across different learner or year group cohorts).
- Which lessons EdTech was being used in and not used in.
- Number of users (staff, learners and parents/carers) that had signed up to a digital platform.
- The types of technology that staff had used across a year and their views on using it. For example, one school had created a self-assessment report for staff which asks staff to log which technology they have used (over an annual period) and how they feel about using it. This is then reviewed by the senior leadership team.

Practice example – Using monitoring data to encourage and support EdTech use

This single academy secondary school implemented teaching and learning software. In addition to wider review of the use of the software including through individual enquiry projects, and discussions with a teaching and learning group, the EdTech lead was able to access data directly from the software. This included data on who was using the software, how frequently and in what subjects. This enabled the EdTech lead to have individual conversations with staff who were using it a lot to explore the impact of using the software. However, it also allowed the lead to have targeted conversations with staff and departments who were using it less frequently to explore barriers and confidence in use. This helped them plan further support for staff who needed it, such as, pairing a less confident staff member with a more confident peer within or across departments.

For some EdTech software that schools, and colleges had implemented, there were in-built mechanisms within the technology that could be used to monitor usage. For example, software that provided metrics on log-ins, or time spent on the app, or provided other reports. For other types of technology, other less data driven approaches (such as dropping into lessons to check usage or speaking to staff and users about usage) were utilised as an alternative way of measuring usage.

7.3 Obtaining user feedback

Most schools and colleges were collecting frequent user feedback (from staff, parents and learners) on EdTech they had introduced. The frequency and mechanisms for this user feedback varied, although ensuring there was ongoing dialogue with users allowed the school or college to more confidently know how the technology had been received by those using it. Mechanisms for collecting user feedback in EdTech was embedded either within existing monitoring or feedback cycles (for example, as part of the collection of wider feedback on school practices) or as a stand-alone feedback process.

Examples of approaches that schools and colleges were using included:

- Ongoing discussions with staff using formal mechanisms (such as departmental or curriculum meetings, staff meetings or CPD sessions) or informal approaches (such as through discussions with departments), to establish how confident staff felt using EdTech and whether they felt it had impacted on their practice.
- Surveys of learners, staff and parents/carers (where appropriate), to obtain feedback on perceptions of using Edtech.

  > After the first two weeks of use, we sent a sent a survey to staff and learners focusing on use and issues. Every subject area (except dance) had used the [hardware]. We will do another survey at the end of spring term to monitor things. If the [hardware] is used regularly then that is a good indicator that it's good value for money. – *Senior leader, Secondary MAT*

- Obtaining feedback from staff after EdTech training sessions which was then used to help shape and further develop training based on further needs.
- Developing impact and case-study stories, to showcase and highlight where the implementation of EdTech has worked well.

Practice example – monitoring EdTech implementation at a MAT level

At a MAT level, to monitor EdTech implementation, key performance indicators (KPIs) were set which allowed the MAT to benchmark technology use. They were also increasingly using net promotor scores (NPS) as a metric for measuring how likely those using the technology would be to recommend its use to others. For example, they had collected NPS data on the management information system that they have just rolled out across the MAT. The MAT also set additional KPIs specific to a particular piece of EdTech (such as usage, intended impacts and benefits).

7.4 Summary of what works when monitoring and evaluating technology implementation

The following key success factors were identified by schools and colleges.

- Seeing EdTech in practice. This was achieved through:
  - Learning walks, classroom and teaching observations.
  - Pedagogy coaching team observations and feedback.
- General assessment within lessons.

- Monitoring EdTech usage to establish whether technology is being used as expected – frequency of use, number of users etc.
- Obtaining frequent user feedback through multiple mechanisms to understand how technology has been received by those using it. This included surveys of learners, staff and parents/carers, ongoing discussions with staff using formal or informal mechanisms, and developing impact case-studies.

8. Challenges

Schools and colleges recognised that even where EdTech had been implemented effectively within their setting, there were challenges encountered that were either difficult to control for or challenging to overcome due to external or logistical factors. The challenges that schools and colleges mentioned related to technology implementation in a wider sense, rather than related to a specific type of technology or the context in which they were operating.

At an infrastructure level the challenges mentioned by schools and colleges included:

- The ability for the school or college infrastructure to support new technology being introduced. For example, having sufficient or reliable Wi-Fi or internet connection, appropriate hardware to be able to support use (such as having an appropriate number of devices, or the devices being fit for purpose), and having the appropriate security in place (both cyber and physically, to avoid devices going missing, or cyber security breaches).
- Having the available budget to purchase new and affordable technology.
- The capacity of technical staff to implement new EdTech and the balance with other ongoing technical responsibilities within the setting.
- Being able to meet the ongoing costs of EdTech upkeep. For example, needing to update infrastructure or hardware on an ongoing basis to ensure it is fit for purpose.
- The integrating of new EdTech with existing systems to ensure compatibility and alignment.

At a teaching and learning level the following challenges were mentioned:

- The tension of wanting to test and implement new and innovative technology to enhance the learner experience with considerations of the impact on learner outcomes (particularly if there was a limited evidence base).
- The impact of implementing technology on the teaching and learning delivery model (particularly for colleges) including consideration of whether introducing technology will be more appealing to potential learners and what the return on investment would be.
- Teachers being creative enough to understand how best to utilise EdTech within their teaching to maximise the impact for learners.
- The logistics of using technology efficiently and effectively in the classroom (for example devices not being charged, log-in difficulties).

- Being able to find age appropriate EdTech resources at key stage 2 that would also be engaging for lower ability key stage 3 learners who may be unable to access traditional key stage 3 resources.

At a user level, the following challenges were mentioned:

- Differences in staff capabilities, confidence and willingness to use technology, including, staff resistance or reticence to change current practice.
- Keeping staff engaged with technology, particularly when they face difficulties in using the technology because of technical issues; or making sure that the momentum is maintained around staff willingness to adapt to new technology; for example, as they had to through the COVID-19 pandemic.
- Learners being able and willing to adapt to new technology. For example, introducing another platform has the potential to be overwhelming and an additional burden for learners.
- Digital poverty and digital literacy and the effect on learners and families if there is an expectation for them to access technology at home.
- Parents/carers' willingness, attitudes to technology and their skills in being able to use it, such as their willingness to allow their children to access technology, or having concerns that they would not use the technology for the purpose intended.

8.1 Summary of key challenges

- Infrastructure level challenges - including the capacity and security of infrastructure to support new technology implemented, capacity of technical staff, budgets to purchase and maintain technology, and integration of new technology with existing systems.
- Teaching and learning level challenges - including balancing enhancing the learner experience with consideration of the impact on outcomes, managing impact on the teaching and learning delivery model, lack of teacher creativity when using EdTech to maximise learner impact, logistics of using technology efficiently and effectively in the classroom (e.g. charging, logging-in), and finding age-appropriate resources.
- User level challenges - including variation in staff capability, confidence and willingness to use technology, keeping staff engaged in technology use in the face of technical difficulties, learners' ability to adapt to new technology and parents' attitudes towards and skills in using technology.

9. Benefits and impact of technology use

Schools and colleges had introduced EdTech for various reasons and functions (see Section 1.4). This ranged from introducing EdTech for a discrete function, such as, to address a teaching and learning need (for example, introducing a maths app, or using immersive technology within a specific department), to those that had a whole setting approach to EdTech and had introduced technology for multiple functions across their setting (for example, introducing a collaborative platform for use by learners and staff with a focus on teaching and learning and improving communication).

As such, where schools and colleges offered examples of the impact and benefits they had observed from the introduction of EdTech, this was typically based on perceptions of impact. It was also more challenging for schools and colleges to isolate the impacts they had observed to use of a specific type of EdTech.

The impacts reported in this section are therefore presented as generic outcomes and benefits that had been seen by schools and colleges as a result of EdTech use across the following areas:

- Impact on learners.
- Impact on staff.
- Impact on parents/carers.
- Wider school and college outcomes.

9.1 Impact on learners

Many schools and colleges involved in this research had introduced EdTech that had a teaching and learning focus (see section 1.4). Technology was often being used to bolster learning with the aim of improving learner engagement in learning, and outcomes. Technology was viewed as playing a part in strengthening the teaching and learning environment. Where schools and colleges were able to provide examples where they had observed impacts on learners through the use of technology, these included:

- Improvements in learners' engagement and confidence in their learning, for example through learners with SEND having access to assistive technology.
- Improvements in learner progress, such as learners working at a higher level than would be expected,

> Kids are more confident with technology, so we have seen in last couple of years through assessments, the standard of children in year 3 is higher. So, we look at stretching further through use of new technology, and

incorporating it into learning as much as possible, but also at how we can use it to push beyond curriculum expectation. – *Senior leader, Primary LA maintained school.*

- Improvement in the quality of work produced such as writing, vocabulary, and retention.

  And learners are saying my answers are in better shape before they give it to their teacher. So, that means the teacher isn't going to bounce it back to them and they'll have to do loads of corrections to their work. So their confidence rises because they feel better about themselves because they've submitted a better piece of work. That's positive, as it would hopefully encourage them to be better writers in the future. – *EdTech lead, GFE college*

- The ability for learners to act with more autonomy and independence.

  It has opened the learners' eyes to the world and shown them that there are other ways to communicate and express themselves not just through written work. – *Middle leader, Sixth form college*

- Learner skills development. Examples included skills being strengthened in particular subject areas, and improvements in digital skills.
- Improved communication between learners, their peers and teachers. For example, using online remote teaching platforms has allowed learners to communicate more easily with each other and their teachers.

9.2 Impact on staff

Schools and colleges mentioned perceived improvements to staff workload as one of the key benefits they had seen from their implementation of EdTech, particularly where technology had a teaching and learning function. Interviewees commented on the impact on workload including a reduction in the time spent planning lessons and marking learners work (for example, through EdTech that allowed for verbal feedback to be recorded, or by streamlining the process for marking using a collaborative or remote platform). EdTech creating efficiencies in the tasks that staff were undertaking was perceived to be a key benefit of its use. Other perceived impacts included:

- Increasing staff confidence and skills in the use of EdTech.

  It's building teachers confidence so that they can challenge children more. We had a teacher who didn't even know how to turn a

computer on and we helped and supported her to build her confidence. – *Senior leader, Primary LA maintained school*

- Enhancing and encouraging creativity in teaching, for example by using EdTech to allow teachers to teach topics in a different way.
- Supporting assessment processes, through EdTech supporting teachers to better know where learners are in their learning. For example, subject specific software with in-built formative assessment tools (such as quizzes) can help teachers to know how learners are progressing and where the gaps are in their knowledge.

These findings align with the literature review (see Appendix 3) which found that benefits of Edtech included saving teachers time in having to mark learners' work and the immediate availability of learner achievement data.

Practice example – Reducing teacher workload through the use of EdTech

This secondary school within a MAT invested in an online collaborative platform that aimed to support them in introducing a more blended approach to learning (prior to COVID-19 pandemic), supplementing what they did traditionally in the classroom with the greater use of technology. The school used the platform to upload lessons and resources, and for submission of homework and marking of homework.

The school perceived that introducing the platform has helped both with teachers' workload around planning and had made their marking more effective. By allowing teachers to upload all lessons, revision guides and resources, it has created considerable workload efficiencies (for example reducing the time spent photocopying or producing resources). It has also improved consistency in homework setting, which has enabled teachers to address historical issues with homework completion as it can be monitored more easily through the collaborative platform.

9.3 Impact on parents/carers

A number of schools and colleges interviewed had introduced EdTech that had aimed to streamline or support more consistent communication with parents/carers or had encouraged parents/carers to become more involved in their child's learning.

Introducing the use of collaborative platforms or systems for setting work and communicating with staff and parents (for example, setting homework or facilitating virtual parents' evenings), along with parents/carers being able to monitor learner attendance and progress, were some of types of EdTech functions that schools and colleges mentioned using. Reported impacts of using such technology included:

- Parents/carers having a clearer understanding of the expectations of the school or college in relation to homework.
- Parents/carers being more engaged in their child's learning and having clearer understanding of their progress.
- Increase in attendance at parents' evening (when run virtually) because they are able to access more flexibly and around other responsibilities.

9.4 Wider school and college outcomes

Schools and colleges found it more challenging to cite examples of the impact of EdTech at a wider level, however a small number were able to give illustrative examples of where they had observed impact from implementing technology. These included:

- An improvement in a secondary school's exclusion rate (from 25% to less than 10%) as a result of introducing a management information (MI) system that strengthened their behaviour management approach and monitoring.
- A school attracting a higher number of job applications because they are becoming well known for their innovative and embedded approaches to using EdTech.
- A primary school involved in the research mentioned that their school performance had been in the bottom 10% and that this had now improved to the point where they were now in the top 0.5% in the country. The Headteacher felt that although this was not solely down to technology, it had played a key role in this improvement.
- Cost efficiencies, such as reduced photocopying and paper costs.
- Time savings, such as through having EdTech that can produce quick reports (for example, attendance or behaviour reports).

9.5 Summary of perceived impacts and benefits

Whilst it was difficult for schools and colleges to extrapolate impacts directly and explicitly related to use of technology, they were able to provide their perceptions of the benefits:

- Learners - improved engagement, confidence, skills, quality of work, independence, progress and communication between peers and teachers.
- Staff - reduced workload and improved efficiency, increased confidence and skills in EdTech use, enhanced creativity in teaching and improved assessment processes.

- Parents/carers - greater engagement in their child's learning, clearer understanding of homework expectations and improved parents' evening attendance.
- Wider school and college outcomes - examples included improved attendance and exclusion rates, increased job applications, improved school performance, cost and time efficiencies.

9.6 Case study 6: Embedding and evaluating a cloud-based, real-time reporting system

Ark Elvin Academy has used cloud-based technology to maximise its use of data to support learners' attendance, behaviour and achievement, in order to be more proactive in its approach. To achieve this, the secondary school has extended the functionality of its cloud-based MIS system in two ways; managing the launch of the companion apps to both parents and staff; and introducing additional data processing and reporting software. The staff app enables staff to instantly log data on a phone or other device, the parent app allows parents to view and respond to pupils' attendance and behaviour in real time, and the data processing and reporting software allows the school to create reports and generate insights tailored to its needs. This enables more joined-up functionality and supports efficiency.

The ease with which bespoke reports are generated and their usefulness has been invaluable to creating a data-informed culture at the school. Pastoral leaders, for example, review pupils' behaviour data at the end of each week to identify any issues or patterns emerging, they put in place interventions to support pupils to get back on track quickly so that the focus can return to their learning. This proactive data-led approach has contributed to improved behaviour and a significant reduction in exclusions at the school. This is done without additional workload as the collection of such data is built into teachers' work in the classroom. They record behaviour and attendance events as they happen in lessons or around the school. At network level, the effective collection and forensic analysis of attainment and progress data is used by departments to generate reports, identifying learners who require intervention when they are not making sufficient progress.

Working with end users like Heads of Year to understand their needs and 'non-technical' staff to test and trial reports generated by the software, has been integral to this process so that it achieves what is required and is simple to use. This collaborative approach to developing systems has been key to the successful implementation and embedding of the school's systems and processes as potential issues are considered and solutions found.

The use of data is integrated into staff daily, weekly and termly tasks so that, for example, line managers are able to check the extent to which the technology is being used for its intended purpose. This can inform conversations around consistency of use and, importantly, can also help identify barriers around usage, or inform developments to support fitness for purpose.

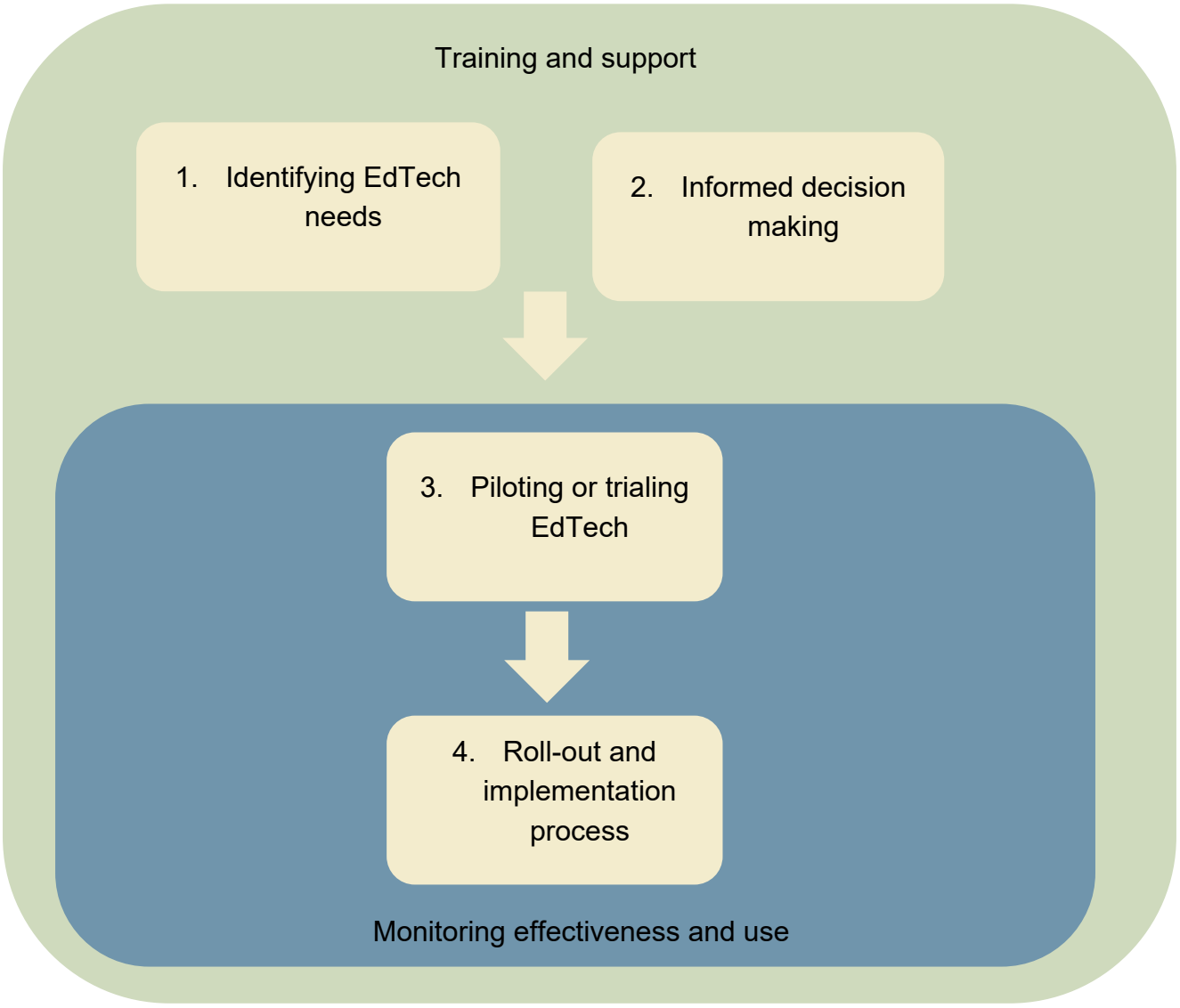
User feedback is critical to the development, implementation and evaluation of the software. It enabled the school to understand the impact on staff workload reduction though instant ‘one click’ report generation and to generate ideas to inform further improvement.

Impact is also evaluated in terms of improvement against school priorities. For example, the school’s fixed term exclusion (suspension) rate (as a percentage of the pupil group) has decreased from 28 per cent (in 2016/17 before the data systems were introduced), to 10 per cent in the last academic year, while attendance has also improved through better tracking. Both are attributed, in part, to the use of data through the school’s technological systems.

10. Summary and conclusions

This research identified a series of stages, key features and approaches to effectively implementing technology. Figure 1 identifies the key elements that schools and colleges considered to be important. It highlights that successful implementation goes beyond the process of roll-out itself and that sound planning and preparation are critical steps. In particular, it is important to understand what need the technology would be addressing and to consider the evidence in order to make an informed decision. Piloting or trialling new technology was utilised in various forms (although not always) and was similar in nature to approaches to roll-out which could occur in a phased or wholescale way, embedding learning from the pilot, and from ongoing monitoring and evaluation. Fundamental to the successful implementation and embedding of technology, and enveloping the whole process, is training and support.

Figure 1: Key features in successfully implementing EdTech



10.1 Identifying EdTech needs

Identifying the need or priority for the technology to be introduced was the first and critical step. Schools and colleges used approaches such as formal reviews, staff consultation or using EdTech leads or wider staff to feed into the identification of need. Having an EdTech or digital strategy also supported this process as it allowed schools and colleges to consider how technology implementation aligned with their wider vision or goals for EdTech use.

10.2 Informed decision making

Researching and sourcing technology allowed schools and colleges to identify what technology was available and it was common for them to use recommendations from education professionals, information from technology providers and advice from EdTech partners to inform this decision-making. Using multiple sources of information, helped schools and colleges to ensure that they were making the right decisions for their setting. Collaboration supports effective reflection and decision making and frameworks, where used, helped schools and colleges to ensure that the process of digital strategy and transformation was fully thought through.

10.3 Piloting or trialling EdTech

Piloting new technology helped schools and colleges to more fully explore the effectiveness of the EdTech chosen, and also whether there were any potential issues or challenges if it was to be rolled out further.

This involved schools and colleges initially testing the technology to assess functionality and suitability, effective pilot planning and preparation, user testing and then reviewing and evaluating the findings to establish whether and how best to proceed with implementation. Piloting with a range of users and ‘test’ and ‘control’ group approaches helped to provide rich data for evaluating suitability. Dedicating ring-fenced time to exploring and piloting new technology ensured the process was prioritised.

10.4 EdTech implementation process

After schools and colleges had decided to continue with rolling out EdTech, they went through further steps that began with planning for implementation, for example, reviewing the pilot data, developing an action plan, and setting expectations for use. Prior to roll-out, assessing and preparing the infrastructure allowed schools and colleges to ensure that their current infrastructure was sufficient to support any new technology being implemented. For new whole-school or college systems or a large volume of technology

(for example introduction of one-to-one devices), being able to confidently say that the infrastructure could support the new EdTech was key.

Engaging users was seen as being fundamental to effective implementation. Schools and colleges had considered how they were communicating the vision and approach for EdTech to users, including demonstrating senior leadership engagement and commitment.

During implementation, in order to further embed its use, schools and colleges were considering how the EdTech could be aligned and integrated into wider systems. For example, how EdTech could be integrated into teaching and learning systems, or whether school policies needed to change to reflect new EdTech implementation.

10.5 Training and support

Training and support underpinned all aspects of the implementation process. Being able to offer flexible, accessible training and support to users throughout all stages was seen by schools and colleges as being central to successful implementation. It supported user engagement and also ensured that users had the skills and confidence to use the EdTech, maximising the value and potential impact of the technology in the setting. Offering upfront training, alongside ongoing support, and utilising various formats for this support (for example, remote and face-to-face), ensured that EdTech implementation remained a priority and that the value and benefits of using it remained at the forefront. Allowing time for users to practice and familiarise themselves with new technology, and differentiating and personalising training and support, helped to encourage engagement.

10.6 Monitoring effectiveness of EdTech

Similarly, building in approaches to monitoring and reviewing effectiveness and impact was an ongoing process for schools and colleges that spanned the implementation approach. Reflecting on implementation, and delving into how EdTech was being used, how users were engaging with technology and whether there were any issues or challenges, allowed schools and colleges to be able to adapt or refine their approach or offer further training or support as needed. Quantitatively measuring the impact of technology implementation on learner and staff outcomes was more challenging and schools and colleges may benefit from more support with this aspect.

Appendix 1: Engagement and screening survey summary

This section summarises the data from the engagement and screening survey.

Sample profile

To supplement the virtual roundtable as a source for school and college selection, a short online survey was sent to 565 schools and 252 colleges to further identify schools and colleges for involvement in the research. The sample of schools was selected from the register of schools and colleges in England, 'Get information about schools' (GIAS), using a stratified random sampling approach (stratified by phase and type). Sampling of secondary schools was upweighted to increase the numbers of responses achieved for the qualitative sample selection (primary 415, secondary 150). The profile of the schools contacted is detailed in Table 3.

Table 3: Profile of schools and colleges sampled

School / college profile	Number of schools / colleges
Phase	
Primary	415
Secondary	150
College	252
Type of school	
Single academies / free schools	43
Local authority (LA) schools	286
Part of a multi-academy trust (MAT)	236
Type of college	
General further education (GFE) college	164
Sixth-form college	47
Specialist / land-based / other college	41

Source: GIAS 3rd January 2022

In total, 43 schools and 28 colleges (total of 71) completed the online survey. The majority of schools were primary schools (n=30), followed by secondary schools (n=12)

and 1 all through school. Half (n=6) of the secondary schools had a sixth-form. Colleges were primarily a mix of general further education colleges (n=16) and sixth-form colleges (n=11), with 1 response received from a specialist land-based college.

Summary of responses

Presence of a digital technology strategy

Two-thirds (66% n=47) of schools and colleges that responded to the online survey had a digital technology strategy in place and a further quarter (24%, n=17) said their digital strategy was in development (Table 4). A school or college-specific strategy was most common (49%, n=35), followed by a Trust or group-wide strategy (14%, n=10). Just 2 schools had a local authority strategy. A minority of schools and colleges said they did not have a digital strategy (4%, n=3), or they were unsure (6%, n=4).

Table 4: Digital technology strategy for school or college

Type of digital strategy	Percentage
Yes - we have a school / college-specific strategy	49%
Yes - we have a Trust / group-wide strategy	14%
Yes – we have a local authority strategy	3%
Not yet - in development / planning	24%
None	4%
Don't know	6%

Base: All respondents n=71

Source: Engagement and screening survey

Implementation of new technology

All but one of the schools and colleges said they had implemented new technology in the previous 2 years. The functional areas where new technology had been implemented are outlined in Table 5. It was common for technology to have been implemented across multiple functional areas, with a mean of 8.2 areas mentioned. Technology to support remote teaching and learning (89%, n=63) was the most common area cited, followed by technology to deliver lessons (77%, n=55) or to support blended learning and innovative teaching (72%, n=51). This is unsurprising given that schools and colleges had been closed during some of 2020 and 2021 due to the COVID-19 pandemic. Just over two-thirds (69%, n=49) of schools and colleges had implemented new technology to support delivering teacher training or continuous professional development (CPD) and just over

half had implemented technology to support teacher collaboration (56%, n=40), parental engagement (55%, n=39) and independent or online learning (54%, n=38).

Table 5: Functional areas new technology has been implemented in within previous 2 years

Functional area	Percentage
Supporting remote teaching and learning	89%
Delivering lessons	77%
Supporting blended learning and innovative teaching	72%
Delivering teacher training / CPD	69%
Collaborating and sharing resources with other teachers	56%
Parental engagement / communication	55%
Offering independent / online learning (including in class)	54%
Supporting learners with SEND	49%
Planning lessons / curriculum content	48%
Data storage	46%
Communication with and delivery of governance	44%
Conducting formative or summative assessments	42%
Financial management	35%
Learner data management	35%
Pastoral support and activities	35%
Timetabling	11%
Other[17]	6%
None	-
Don't know	1%

Base: All respondents n=71

Source: Engagement and screening survey

Other functional areas were mentioned by less than half of schools and colleges. They were least likely to have implemented technology for school management functions such

[17] Other mentions centred around software, infrastructure and security upgrades.

as timetabling (11%, n=8), pupil data (35%, n=25%) or financial (35%, n=25) management, or for pastoral support (35%, n=25).

It was not possible from the survey data to identify whether the technology implemented was different for each functional area, or whether it was used across multiple functional areas. However, during the follow-up telephone calls and interviews, it was common for schools and colleges to utilise technology across functional areas.

Schools and colleges were asked to indicate the types of technology (software such as programmes or apps, hardware such as devices, or infrastructure such as servers, cloud storage or networking), that they had implemented in each functional area mentioned (Table 6). Software was the most common type of new technology implemented across all functional areas, with the exception of data storage, which was primarily infrastructure technology.

Implementation of new software was most common for teaching and learning and communication functions, such as conducting formative or summative assessments (93%, n=28), parental engagement or communication (92%, n=36), planning lessons or curriculum content (91%, n=31). Hardware implementation was most common for supporting learners with send (83%, n=29), delivering lessons (80%, n=44) and supporting remote teaching and learning (76%, n=48). Infrastructure was most commonly implemented for data storage (85%, n=28) and collaborating and sharing resources (65%, n=26).

Table 6: Types of new technology implemented by functional area

Functional area	Number of mentions	Software %	Hardware %	Infrastructure %
Remote teaching and learning	63	87%	76%	52%
Delivering lessons	55	85%	80%	40%
Blended learning / innovative teaching	51	88%	73%	51%
Teacher training / CPD	49	86%	51%	31%
Collaborating and sharing resources	40	75%	45%	65%
Parental engagement / communication	39	92%	13%	18%
Independent / online learning	38	89%	74%	45%
Supporting pupils with SEND	35	89%	83%	29%
Planning lessons / curriculum content	34	91%	56%	47%
Data storage	33	30%	30%	85%
Governance	31	87%	32%	32%
Assessments	30	93%	37%	30%
Financial management*	25	88%	12%	52%
Learner data management*	25	72%	28%	48%
Pastoral support and activities*	25	84%	60%	28%
Timetabling*	8	88%	25%	38%

Base: All implemented new technology by functional area[18]

* indicates a low base (less than n=30)

Source: Engagement and screening survey

In the majority of cases, technology implementation was at more advanced stages, either being more widely implemented or fully embedded (Table 7).

[18] Other mentions (n=4) not shown.

Table 7: Stage of implementation by functional area

Functional area	Number of mentions	Research / sourcing %	Pilot / trial %	Implement %	Embed %	Review %
Remote teaching and learning	63	2%	2%	29%	54%	14%
Delivering lessons	55	2%	2%	27%	51%	16%
Blended learning / innovative teaching	51	2%	10%	27%	51%	10%
Teacher training / CPD	49	-	6%	33%	49%	10%
Collaborating and sharing resources	40	-	5%	28%	55%	13%
Parental engagement / communication	39	3%	3%	36%	44%	13%
Independent / online learning	38	-	8%	24%	55%	11%
Supporting pupils with SEND	35	3%	11%	43%	31%	11%
Planning lessons / curriculum content	34	-	6%	26%	47%	21%
Data storage	33	3%	6%	24%	55%	9%
Governance	31	-	-	32%	55%	10%
Assessments	30	-	10%	37%	43%	10%
Financial management*	25	4%	16%	32%	32%	8%
Learner data management*	25	-	-	36%	48%	12%
Pastoral support and activities*	25	-	16%	40%	40%	4%
Timetabling*	8	-	13%	38%	38%	-

Base: All implemented new technology by functional area[19]

* indicates a low base (less than n=30)

Source: Engagement and screening survey

[19] Other functional area mentions (n=4) and 'Don't know' responses not shown.

The vast majority (88%, n=512 mentions) of implementation took place across the whole school or college setting. For around one-tenth (11%, n=66 mentions) of the functional areas mentioned, implementation took place only in certain departments. For the remainder of functional areas where new technology had been implemented, respondents were unsure.[20] Similarly, amongst schools and colleges that were part of a MAT or group, the majority of implementation took place across all of the settings (77%, n=163 mentions), with less than one-tenth (7%, n=43 mentions) taking place in some schools or colleges in the group, but not all.[21]

Perceptions of implementation success

Respondents were asked to rate how successful they felt the implementation of new technology in the functional areas mentioned had been so far on a scale of 1-10, where 1 represented 'not at all successful' and 10 represented 'extremely successful'. Table 8 shows their responses aggregated into net scores (1-3, 4-7, 8-10). Perceptions of the success of implementation so far were somewhat mixed. Implementation was felt to have been most successful for new data storage technology, with 82% (n=27 mentions) giving a score of 8-10 out of 10. Around two-thirds felt that implementation of technology to support learner data management (68%, n=17 mentions), remote teaching and learning (67%, n=42 mentions) and blended learning and innovative teaching (65%, n=33 mentions) had been successful so far.

[20] Don't know responses 1%, n=7 mentions.
[21] Don't know responses 1%, n=6 mentions.

Table 8: Perceptions of success of implementation by functional area (1-10)

Functional area	Number of mentions	Don't know	NET Rating 1-3 %	NET Rating 4-7 %	NET Rating 8-10 %
Data storage	33	6%	0%	12%	82%
Learner data management*	25	4%	4%	24%	68%
Remote teaching and learning	63	2%	0%	32%	67%
Blended learning / innovative teaching	51	2%	0%	33%	65%
Independent / online learning	38	5%	3%	29%	63%
Supporting learners with SEND	35	3%	0%	34%	63%
Teacher training / CPD	49	4%	0%	35%	61%
Delivering lessons	55	2%	0%	38%	60%
Collaborating and sharing resources	40	3%	0%	38%	60%
Assessments	30	3%	0%	37%	60%
Pastoral support and activities*	25		0%	40%	60%
Governance	31	3%	0%	39%	58%
Financial management*	25	12%	0%	36%	52%
Parental engagement / communication	39	5%	5%	44%	46%
Timetabling*	8	13%	13%	38%	38%
Planning lessons / curriculum content	34		0%	62%	38%

Base: All implemented new technology by functional area[22]

* indicates a base of less than n=30

Source: Engagement and screening survey

[22] Other functional area mentions (n=4) not shown.

The majority of implementation in other functional areas was felt to have been moderately successful, with between 58% and 63% providing a rating of 8-10 out of 10. Implementation was rated as least successful for timetabling, however the number of mentions for this functional area was very low (n=8) so this finding should be treated with caution. Other areas where implementation had been somewhat less successful were planning lessons or curriculum content (NET 8-10 38%, n=13 mentions), parental engagement or communication (46%, n=18 mentions) and financial management (52%, n=13 mentions).

Barriers or challenges experienced when implementing new technology

Schools and colleges experienced a number of barriers when implementing new technology, with a mean of 6.4 mentioned on average (Table 9). The most common barriers were around learners' access to technology at home, with around three-quarters citing learners' access to digital devices (77%, n=55) or broadband or connectivity (73%, n=52) at home as a challenge. Two-thirds (66%, n=47) felt that parents' or learners' digital skills presented a barrier to implementing new technology. This perception is likely to have been exacerbated by the need for wide-scale remote teaching during school closures as a result of the COVID-19 pandemic in 2020 and 2021.

Organisational barriers were also frequently mentioned, the most common being the costs of technology (72%, n=51), budgetary constraints (66%, n=47) and staff skills and confidence with technology (68%, n=48). Around two-fifths (42%, n=30) of schools and colleges said their broadband or wireless connectivity was a barrier. Many schools and colleges would also benefit from greater awareness or knowledge about what technology or approaches work well as 41% (n=29) mentioned experiencing this barrier.

Table 9: Barriers or challenges experienced when implementing new technology

Barriers or challenges	Percentage
Learners' access to digital devices at home	77%
Broadband or connectivity for learners at home	73%
Cost of technology	72%
Staff skills and confidence with technology	68%
School / college budgetary constraints / priorities	66%
Parents' or learners' digital skills	66%
Broadband / wireless connectivity in school / college	42%
Lack of awareness or knowledge about what technology or approaches work well	41%
Availability of technology in school / college	37%
Staff willingness to use technology	35%
Safeguarding and data concerns	35%
Parental concerns (e.g. safeguarding, data security, screen time etc)	14%
Limited procurement guidance	13%

Base: All respondents n=71

Source: Engagement and screening survey

Appendix 2: Profile of schools and colleges interviewed

Table 10: Profile of schools (successful implementation)

Size by phase	Number of schools
Primary large	2
Primary medium	1
Primary small	3
Secondary large	2
Secondary medium	4
Secondary small	1
% FSM	
High	1
Medium	6
Low	6
Ofsted	
Outstanding	1
Good	7
N/A	5
Region	
North west	3
North east	1
East of England	2
London	4
South East	2
South West	1

Appendix 3: What works in EdTech implementation - rapid literature review

Introduction

As defined in the Department for Education (DfE) EdTech Strategy, (2019), 'Education technology (EdTech) refers to the practice of using technology to support teaching and the effective day-to-day management of education institutions. It includes hardware (such as tablets, laptops or other digital devices), and digital resources, software and services that help aid teaching, meet specific needs, and help the daily running of education institutions (such as management information systems, information sharing platforms and communication tools).'

Following significant developments in the use of EdTech in schools and colleges since the COVID-19 pandemic, the DfE has initiated a programme of research to understand what works in EdTech, to establish a strong evidence base for effective use of technology and embed this across the school system, so that it is easy for schools and families to use the best products at the right time.

To inform this programme of work, the DfE commissioned CooperGibson Research to conduct research with the aim of better understanding how new education technology is successfully rolled out and embedded in schools and colleges.

The project was designed around the following research questions:

- How do schools and colleges select which EdTech products (hardware or software) to invest in?
- How do schools and colleges implement the products successfully (eg. training, type of product, infrastructure, leadership style, procurement and resource management etc.)?
- What are the critical success factors for a school or college to be able to embed a new product well?
- Do some EdTech products work better in different types of educational settings (eg. size, phase, key stage etc.) or for different levels of digital maturity?
- What are the barriers and challenges faced by schools and colleges when implementing and embedding new technology and how are they overcome?
- What impact does the use of this new technology have (on workload, learner progress and engagement, costs etc.) and what are the key features of the implementation/embedding process which cause these impacts?

This section presents the findings of a rapid literature review based on the above research questions. It forms the initial stage of the research, to be followed by a series of depth interviews with schools and colleges exploring their experiences of EdTech implementation.

Aims of the literature review

The overall aim of the rapid review was to analyse the available literature on the implementation of EdTech to:

- Inform the content of the survey and interview instruments used in this report.
- Contribute to the wider understanding of the DfE's 'what works' in EdTech programme.

Approach

Scoping review

The initial scoping review was used primarily to assess the breadth and depth of the available literature, confirm inclusion/exclusion criteria, and the keywords and databases to be drawn upon for the main literature searches. The parameters for the original research focused on research in the past two years, in England and in the school and further education sectors. The initial scoping exercise showed that there was limited research conducted in England. Therefore, country parameters were broadened to include examples of international studies if they served to illustrate an important finding or specifically addressed a research question. All literature related to online and/or remote learning over the past two years was not included as this was the focus of a separate report. A detailed breakdown of the criteria for the full search review are in Appendix 4. A list of the final search terms and combination of search terms are in Appendix 5.

Main review of evidence

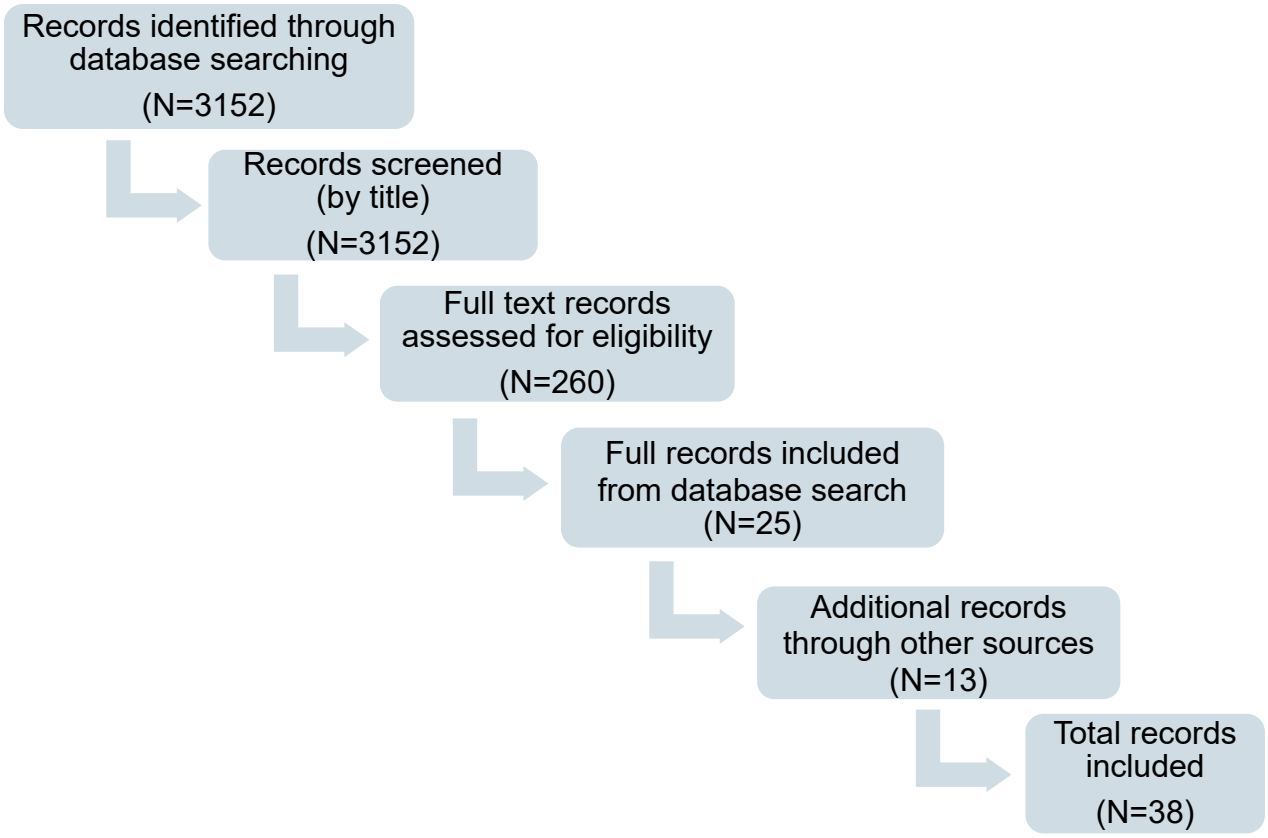
A data search was performed of peer-reviewed scientific articles and grey literature, using the Proquest[23] database. Searches focused on literature published in English from 2020 onwards and included national and some international accounts. The literature was collated with the support of qualitative data analysis software (NVivo) to enable efficient

[23] ProQuest Central is the largest multidisciplinary database with over 11,000 titles, and over 8,000 titles in full-text. Over 160 subject areas are covered including business, education, economics, health and medical, news and world affairs, technology, social sciences and more. https://about.proquest.com/libraries/

coding of key themes. Evidence was then sifted adopting realist synthesis approaches,[24] which enabled the review to be informed by the research questions.

The initial search produced 3152 records. After screening at title level, 260 met inclusion criteria. These were then read at abstract level resulting in 25 being identified as meeting the inclusion criteria and therefore, were included in the review. As a result of broader internet searches, reference list searching and professional recommendations, a further 13 records were added making a total of 38 records. (Figure 2). These records comprised of peer reviewed empirical studies (n= 11), literature reviews (n=10), meta-analysis (n=2), position papers (n=2), reports (n=5), published digital frameworks (n=5) and website sources (n=3).

Figure 2: Literature searching and screening process



Findings

The following sections of this chapter provide a summary and analysis of the collated literature.

[24] Rycroft-Malone, J., et al (2012), 'Realist synthesis: illustrating the method for implementation research', *Implementation Science* 7:33.

How do schools and colleges select which EdTech products to invest in?

The searches found nine records that met the review criteria. Four of the records were peer reviewed empirical studies; with two using surveys (United States and Croatia) and the other study (Sweden) adopting teacher focus groups[25]. There were two peer reviewed position papers. The remaining records comprised of a report (England), a European Commission framework and one website record.

The review analysis identified four key considerations when schools and colleges are selecting EdTech products:

- Clarity on the specific need and/or priority that the EdTech product will address.
- If selecting EdTech to support learner learning, ensuring selection is informed by pedagogy and an understanding of how EdTech can effectively enhance learner learning.
- The importance of undertaking a preliminary impact assessment for all user groups and setting infrastructure.
- The need to interrogate the evidence base available for individual EdTech products.

Clarity on the specific need and/or priority that an EdTech product will address

There was no empirical evidence (that met search criteria) relating to the selection process. However, a common finding from guidance sourced through the search, was the need for clarity on the specific need and/or priority to be addressed by an EdTech product.[26,27,28] Questions to consider included, for example, whether the product is aiming to improve learner achievement, improve parental engagement or address teacher workload concerns. Moreover, being clear on what problem the EdTech product will solve helps to prevent professionals from being 'distracted' by the latest device or programme just released on the market.

[25] (N.B. This study published two journal articles).
[26] Education Endowment Foundation. (2019). *Using Digital Technology to Improve Learning*. Available at: https://educationendowmentfoundation.org.uk/education-evidence/guidance-reports/digital (Accessed: 14th January 2022).
[27] EdTech Evidence Group. (2020). *Five things to consider when investing in EdTech*. Available at: https://learning.sparx.co.uk/hubfs/Five%20things%20to%20consider%20when%20investing%20in%20EdTech.pdf (Accessed: 14th January 2022).
[28] Teräs, M., Suoranta, J., Teräs, H., & Curcher, M. (2020). Post-Covid-19 education and education technology 'solutionism': A seller's market. *Postdigital Science and Education*, *2*(3), 863-878.

An informed understanding of how EdTech can effectively enhance learner learning

If the identified need on a setting is one with a focus on pedagogy and learner learning, EdTech implementation is more likely to be successful if the process is informed by an understanding of how technology effectively enhances learner learning.

> 'While technology-enhanced learning can appear on the surface to be quite a simplistic phenomenon, in reality, it is deceptively complex, with its various actors, their diverse assumptions, intentions, and background knowledge, the numerous technologies at peoples' disposal and their various attributes, all within the context of attempting to facilitate learning.'[29]

Two conceptual models to support professionals in the complex process of integrating technology into teaching and learning were frequently cited in the empirical studies and guidance literature. These models seek to bridge theory with practice and enable professionals to make more informed technology adoption decisions. The two models were the:

- Technological Pedagogical and Content Knowledge Framework (TPACK)[30] which acknowledges and considers the complex interaction that needs to be understood between content knowledge (what is taught), pedagogy knowledge (how it is taught) and technology knowledge, as the basis for adopting any EdTech to enhance learner learning.
- Substitution, Augmentation, Modification and Redefinition Model (SAMR)[31], a four-level taxonomy (aligned with Bloom's taxonomy) approach for selecting, implementing and evaluating technology.

One non-experimental correlation study of the integration of technology into the mathematics curriculum with 644 learners taught by eight teachers in one United States middle school, used the four levels of the SAMR model (Table 11) to describe the level of technology integration by the teachers and to evaluate the impact of technology on learner achievement in mathematics.[32]

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[29] Bower, M. (2019). Technology-mediated learning theory. *British Journal of Educational Technology*, *50*(3), 1035-1048. p.1035 https://doi.org/10.1111/bjet.12771

[30] Koehler, M., & Mishra, P. (2009). What is technological pedagogical content knowledge (TPACK)?. *Contemporary issues in technology and teacher education*, *9*(1), 60-70. https://www.learntechlib.org/primary/p/29544/

[31] Puentedura, R. (2014). Building transformation: An introduction to the SAMR model [Blog post]. Available at:http://www.hippasus.com/rrpweblog/archives/2014/08/22/BuildingTransformation_AnIntroductionToSAMR.pdf. (Accessed 28th January 2022).

[32] McClain, A., & North, T. (2021). Effect of technology integration on middle school math proficiency: A multiple linear regression study. *International Journal of Education in Mathematics, Science and Technology*, *9*(4), 557-570. https://doi.org/10.46328/ijemst.1456

Table 11: Substitution, Augmentation, Modification and Redefinition Model (SAMR)

Focus	Level	Definition with some examples[33]
Can transform learning	Redefinition	Technology allows for the creation of new tasks, previously inconceivable: • Learners publish their work online where it can be viewed by peers and the broader community. • Recording learners as they deliver a presentation or practice a physical skill, then using this recording to prompt learner reflection.
	Modification	Technology allows for significant task redesign: • Learners produce podcasts summarising a topic, which can then be accessed by other learners as a revision resource. • Learners use a technological tool that makes an abstract concept visible in a hands-on, responsive way (e.g. voyaging on Google Earth to better understand measurement and geography).
Can enhance learning	Augmentation	Technology acts as a substitute with functional gain improvement: • Learners use PowerPoint or Prezi presentation including the use of multimedia. • EdTech programmes that gamify subject knowledge.
	Substitution	Technology acts as a substitute with no functional change: • Learners type their work online instead of handwriting it using pen and paper. • Uploading a worksheet in PDF for learner access, as opposed to photocopying.

The authors found that those learners in the classes of teachers that used technology at the upper levels (modification and redefinition), which results in technology being used to

[33] https://www.3plearning.com/blog/connectingsamrmodel/

transform rather than replacing existing ways of learner learning, achieved better scores in the maths assessment.

Undertaking a preliminary impact assessment for all user groups and setting infrastructure before purchasing an EdTech product

The analysis identified from the literature, the recommendation to conduct a preliminary impact assessment of an EdTech product for all users and a setting's infrastructure. An impact assessment allows for a structured process to consider the implications of implementing an EdTech product for all users and the wider setting before purchasing the product or at least before implementing it.

During the evidence search, several guidance documents were found. These were designed for education professionals and took the form of questions or prompts which might be considered as part of an impact assessment. Table 12 provides a summary of the types of questions for each category (users and infrastructure) drawn from two related sources. The first is the European Framework of the Digitally Competent Educational Organisations known as the DigCompOrg[34] Framework. Comprising of seven key elements and 15 sub-elements that are common to all education sectors, the DigCompOrg provides a conceptual framework that:

- Reflects all aspects of systematically integrating technology into pedagogy and the curriculum.
- Enables policy makers to design, implement and evaluate projects and policy interventions at regional, national or international levels.

The second source is the Framework for Digitally Mature Schools (FDMS) developed from the DigCompOrg and based on a validity and reliability study of the Framework undertaken in 151 schools in Croatia over a two-year period.[35]

[34] European Commission. (2015). DigCompOrg Framework. Available at: https://ec.europa.eu/jrc/en/digcomporg/framework. (Accessed 12th January 2022).
[35] Begicevic Redjep, N., Balaban, I., & Zugec, B. (2021). Assessing digital maturity of schools: framework and instrument. *Technology, Pedagogy and Education*, *30*(5), 643-658. https://doi.org/10.1080/1475939X.2021.1944291

Table 12: Considerations for an EdTech impact assessment

Category	Key considerations
Users	• Teaching learners with special educational needs • Digital competency required of potential users • User views of digital content • User experience • Implications for CPD
Setting infrastructure	• Planning and procurement • Network infrastructure • ICT equipment in the setting • ICT equipment for educational staff • Programme tools in the setting • Technical support • Equipment maintenance • Central repository of digital documents and educational content • Information security system • Licencing control

The searches elicited just one empirical study from Sweden that directly examined the decision-making process by teachers when adopting new technology.[36] Findings from five focus groups with twenty science and technology secondary teachers found that participants focused on:

- How well the research aligned with the national curriculum and how they taught the subject.
- The education design of the product such as graphics and structure of content including whether the content might be better represented in a different type of resource.
- Practical questions including how much preparation time on behalf of the teacher would be required and whether teaching with the resource would fit into the school timetable.

[36] Andrée, M., & Hansson, L. (2021). Industry, science education, and teacher agency: A discourse analysis of teachers' evaluations of industry-produced teaching resources. *Science Education*, *105*(2), 353-383. https://doi.org/10.1002/sce.21607

Interrogating the evidence base before purchasing an EdTech product

The fourth key consideration when selecting an EdTech product, identified during the review, was the importance of making a judgement as to the source of the product and more specifically the credibility behind any claims made by the product designers. As with the previous three considerations, most of the available evidence was in the form of guidance rather than empirical research.[37] Guidance recommends that school and college professionals not only ask EdTech suppliers for the availability of the evidence of impact but also have the knowledge and understanding of the benefits and limitations of the different types of evidence such as, systematic reviews, case studies, blogs and empirical research. However, this was an area investigated in the Swedish study with twenty science and technology teachers. The authors found three key themes describing how the teachers' discussed issues of commercial interest, partiality and bias in evaluating five industry-produced teaching resources. The participants focused on three main questions which are of value for all education professionals when selecting an EdTech product:

- How trustworthy was the producer of the resource.
- What are the interests at stake for the producer of a resource.
- Could the resource be perceived as an advertisement?

Barriers and challenges with implementing EdTech

The searches found seven records that met the review criteria in relation to barriers and challenges of implementing EdTech. Four of the records were peer reviewed literature reviews, one meta-analysis, two empirical studies and one study used a national (England) data set. It is important to note that the empirical evidence relating to barriers was primarily drawn from the experiences and perspectives of teachers. The implications are that the barriers fall into two categories: those external to the professional and secondly, barriers that might be directly attributed to a professional.

It was possible to identity three main types of barriers when implementing EdTech in schools and/or colleges:

- Context related barriers such as leadership and technology infrastructure.
- Education professionals' lack of EdTech knowledge and skills.

[37] EdTech Evidence Group. (2020). *Five things to consider when investing in EdTech*. Available at: https://learning.sparx.co.uk/hubfs/Five%20things%20to%20consider%20when%20investing%20in%20EdTech.pdf (Accessed: 14th January 2022).

- Education professionals' attitudes to EdTech such as feelings of confidence and self-efficacy.

Context barriers preventing effective EdTech implementation

The analysis of evidence from surveys, national data sets and one literature review identified six types of context barriers. These were barriers experienced by education professionals because of structures, provision and/or practice in their settings. One of the most commonly cited context barriers in the literature was **a lack of access to appropriate professional development and training opportunities**.[38,39,40,41] Equally challenging for the effective implementation of EdTech was the impact of **poor infrastructures** in schools and colleges such as unreliable network connectivity and technology incompatibility.[42,43] The **time** required to prepare to use new EdTech and particularly to create new EdTech content was a third context barrier to implementation.[44] **Learners' lack of digital skills** was a fourth barrier.[45] More recent evidence was more likely to report finding **safeguarding issues with online learning and data security** as challenges to implementation.[46]

[38] Galvis, M., & McLean, D. (2020). *How prepared were primary teachers and pupils in England for the shift to online learning?* National Foundation for Education Research. Available at: https://fas.nfer.ac.uk/how-prepared-were-primary-teachers-and-pupils-in-england-for-the-shift-to-online-learning-insights-from-timss-2019/ (Accessed: 12th January 2022).
[39] Department for Education. (2021). *Education Technology (EdTech) Survey 2020-21*. Research Report. CooperGibson Research. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/996470/Education_Technology__EdTech__Survey_2020-21__1_.pdf (Accessed: 19th January 2022).
[40] Escueta, M., Nickow, A. J., Oreopoulos, P., & Quan, V. (2020). Upgrading education with technology: Insights from experimental research. *Journal of Economic Literature*, *58*(4), 897-996. DOI: 10.1257/jel.20191507.
[41] Education & Training Foundation. (2018). Barriers and enablers to the embedding of learning technologies in the delivery of learning, teaching and assessment in the further education sector. Sero Consulting. Available at: https://www.et-foundation.co.uk/wp-content/uploads/2018/05/Sero-Report-for-ETF-on-TEL-Barriers-Enablers_Report-for-publication_Final_1.0-1.pdf (Accesssed:18th January 2022).
[42] Spiteri, M., & Chang Rundgren, S. N. (2020). Literature review on the factors affecting primary teachers' use of digital technology. *Technology, Knowledge and Learning*, *25*(1), 115-128. https://doi.org/10.1007/s10758-018-9376-x
[43] Ibid.
[44] Education & Training Foundation. (2018). Barriers and enablers to the embedding of learning technologies in the delivery of learning, teaching and assessment in the further education sector. Sero Consulting. Available at: https://www.et-foundation.co.uk/wp-content/uploads/2018/05/Sero-Report-for-ETF-on-TEL-Barriers-Enablers_Report-for-publication_Final_1.0-1.pdf (Accesssed:18th January 2022).
[45] Department for Education. (2021). *Education Technology (EdTech) Survey 2020-21*. Research Report. CooperGibson Research. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/996470/Education_Technology__EdTech__Survey_2020-21__1_.pdf (Accessed: 19th January 2022).
[46] Ibid.

Finally, the **fast-moving nature of the EdTech sector** often meant that education professionals could feel overwhelmed by the need to keep up with current developments in the field.[47]

Education professionals' lack of EdTech knowledge and skills

Education professionals regularly cited their own lack of knowledge and skills in using EdTech as a barrier to implementation although the extent to which it was a barrier differed across the literature. In a national online survey of 2,555 head teachers, teachers and technical professionals from 1,012 schools in England in 2021, almost 90% of headteachers and just under 60% of teachers cited skills as a barrier to implementation.[48] A 2021 literature review of 78 studies on primary school teachers' attitudes towards technology use reported that teachers' lack of knowledge and skills varied. They ranged from being somewhat of a limiting factor to being a major challenge to effective implementation.[49]

Education professionals' attitudes to EdTech

Teacher attitudes were commonly reported as a barrier to EdTech take-up and implementation in the literature. A 2020 literature review of 27 studies of primary school teachers' attitudes toward the use of digital technology, identified that take-up was related to teachers' confidence, beliefs and self-efficacy.[50] A 2018 English study comprised of two focus groups with further education lecturers and curriculum managers reported that a lack of confidence with EdTech was an important barrier to implementation.[51] Similarly, teacher anxiety was reported as a common barrier to EdTech implementation in the review of 78 studies concerned with primary school teachers' attitudes towards EdTech.[52] However a further finding of this review, supported by findings from a meta-analysis drawing on a total sample of 37,211 teachers, found a more nuanced, complex and as yet inconclusive picture around the extent to which

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[47] Education & Training Foundation. (2018). Barriers and enablers to the embedding of learning technologies in the delivery of learning, teaching and assessment in the further education sector. Sero Consulting. Available at: https://www.et-foundation.co.uk/wp-content/uploads/2018/05/Sero-Report-for-ETF-on-TEL-Barriers-Enablers_Report-for-publication_Final_1.0-1.pdf (Accesssed:18th January 2022).

[48] Ibid.

[49] Wijnen, F., Walma van der Molen, J., & Voogt, J. (2021). Primary school teachers' attitudes toward technology use and stimulating higher-order thinking in learners: a review of the literature. *Journal of research on technology in education*, 1-23. https://doi.org/10.1080/15391523.2021.1991864

[50] Spiteri, M., & Chang Rundgren, S. N. (2020). Literature review on the factors affecting primary teachers' use of digital technology. *Technology, Knowledge and Learning*, *25*(1), 115-128. https://doi.org/10.1007/s10758-018-9376-x

[51] Education & Training Foundation. (2018). Barriers and enablers to the embedding of learning technologies in the delivery of learning, teaching and assessment in the further education sector. Sero Consulting. Available at: https://www.et-foundation.co.uk/wp-content/uploads/2018/05/Sero-Report-for-ETF-on-TEL-Barriers-Enablers_Report-for-publication_Final_1.0-1.pdf (Accesssed:18th January 2022).

[52] Wijnen, F., Walma van der Molen, J., & Voogt, J. (2021). Primary school teachers' attitudes toward technology use and stimulating higher-order thinking in learners: a review of the literature. *Journal of research on technology in education*, 1-23. https://doi.org/10.1080/15391523.2021.1991864

professionals' attitudes directly or indirectly act as a barrier to implementation.[53] Therefore, it remains problematic to demonstrate a causal relationship between teachers' technology acceptance leading to an increased intention to use technology and subsequent actual technology use.

Factors that support more effective implementation of EdTech in schools and colleges

The searches found twelve records that met the review criteria in relation to supporting effective implementation of EdTech. Five of the records were peer reviewed: one meta-analysis; one literature review and four empirical studies (all international). The remaining records comprised of national and international frameworks, website guidance and one national report. Analysis of the records found evidence for two main factors that supported more effective implementation of EdTech:

- EdTech training, development and learning opportunities for education professionals.
- Context related factors including leadership, school culture and technology infrastructure.

EdTech training, development and learning opportunities for education professionals

Findings drawn from a range of research designs including one meta-analysis, one literature review, one national survey, two international data sets and three international studies using surveys after a period of professional development, all provided evidence for the positive impact of training and development and EdTech implementation.

One meta-analysis (92 studies) of the potential of digital tools to enhance mathematics and science learning in secondary schools found that, if training for teachers had been provided before the implementation of the digital tool, the impact (Effect Size = 0.84)[54] for learner learning outcomes was greater (0.84) compared to interventions without specific teacher training (Effect Size = 0.56).[55]

The searches yielded one literature review of 31 studies that explored the critical factors for the **type of effective professional development activities** to support teachers' technology integration and found the core features of a training programme to include:

[53] Scherer, R., Siddiq, F., & Tondeur, J. (2020). All the same or different? Revisiting measures of teachers' technology acceptance. *Computers & Education*, *143*, 103656. https://doi.org/10.1016/j.compedu.2019.103656.
[54] Effect sizes of 0.2 are considered small, 0.5 medium and 0.8 large.
[55] Hillmayr, D., Ziernwald, L., Reinhold, F., Hofer, S. I., & Reiss, K. M. (2020). The potential of digital tools to enhance mathematics and science learning in secondary schools: A context-specific meta-analysis. *Computers & Education*, *153*, 103897. https://doi.org/10.1016/j.compedu.2020.103897

- Content focus (directly connecting development activities to teachers' priorities and subject areas).
- Active learning (teacher time for reflection, exploration, and evaluation of new technology).
- Duration (sustained over time and allowing for follow-ups and consistent feedback).
- Learner voice (recognising the importance of and facilitating learner opinions and suggestions about technology integration).
- The role of context (tailored to local and regional needs.[56]

Many of these core features are often part of teacher professional learning activities in school. One study explored the relationship between learners' digital competence acquisition, teaching practices and teacher professional learning activities through the analysis provided by 59,452 teachers (4,228 schools in 38 different countries) through using SELFIE,[57] an online self-reflection tool for schools' digital capacity. The study found (using Ordinary least squares (OLS) regressions) that teachers' participation in digital technology learning activities that included some or all of the five key features, was correlated with more effective digital technology implementation particularly when used as part of cross-curricular projects in schools.[58]

In a qualitative study investigating the perspectives of further education lecturers and curriculum managers in England, the availability of relevant 'just-in-time' training was reported as important for more effective EdTech implementation.[59] To support the further education and training sectors, the Education and Training Foundation, in collaboration with Jisc, has published a competency framework (Digital Teaching Professional Framework) for teaching and training practitioners. This is to be used alongside companion professional development activities, to help identify training needs and support progression through the levels of the framework.[60] These include a series of

[56] Yurtseven Avci, Z., O'Dwyer, L. M., & Lawson, J. (2020). Designing effective professional development for technology integration in schools. *Journal of Computer Assisted Learning*, *36*(2), 160-177. https://doi.org/10.1111/jcal.12394

[57] A free online tool developed by the European Commission to help schools to reflect on incorporating digital technologies into teaching and learning. https://schools-go-digital.jrc.ec.europa.eu/

[58] Castaño Muñoz, J., Vuorikari, R., Costa, P., Hippe, R., & Kampylis, P. (2021). Teacher collaboration and learners' digital competence-evidence from the SELFIE tool. *European Journal of Teacher Education*, 1-22. https://doi.org/10.1080/02619768.2021.1938535

[59] Education & Training Foundation. (2018). Barriers and enablers to the embedding of learning technologies in the delivery of learning, teaching and assessment in the further education sector. Sero Consulting. Available at: https://www.et-foundation.co.uk/wp-content/uploads/2018/05/Sero-Report-for-ETF-on-TEL-Barriers-Enablers_Report-for-publication_Final_1.0-1.pdf (Accesssed:18th January 2022).

[60] Education & Training Foundation. (2018). Digital Teaching Professional Framework. https://www.et-foundation.co.uk/supporting/edtech-support/digital-skills-competency-framework/

Reflective Exploration projects focused on the use of EdTech in further education and supporting practitioners to develop their digital skills.[61]

Recognising the complexity of the relationship between teacher attitude and technology implementation and integration, one United States research team investigated the relationship between professional development exposure, teachers' abilities and values, and teachers' quality of technology integration.[62] Using survey responses from 724 middle and high school teachers in 17 schools across a midwestern state, the findings showed that exposure to professional development activities had a positive effect on teacher attitudes' towards technology and on increasing technology integration in classroom practice. However, another United States study of 301 high school teachers from 18 schools, found after one year of technology professional development activities, there were no significant changes in teachers' attitudes and beliefs towards technology but they did see an increase (not significant) in teachers' use of digital resources.[63]

Professional development is one of the six elements of the Self Review Framework (SRF) published by Naace (The Education Technology Association).[64] The framework is a maturity model which supports education settings to plan, implement and evaluate their technology strategy. The other elements address: leadership and management; teaching and learning; assessment of digital capability; safeguarding and resources.

Context related factors that support more effective EdTech implementation in schools and colleges

The relationship between context factors and implementation was not as widely investigated as the impact of professional development activities. The research designs comprised of two literature reviews, one international (United States) empirical study using a pre and post-test survey design, and guidance as part of a published framework or report. However, it was possible to identify three factors that positively affected the implementation of EdTech: leadership; school culture; and technology infrastructure.

The previously described United States study of 301 high school teachers found no statistically significant impact of professional development activities on teacher attitudes

[61] Education & Training Foundation. (2022). *Digital Skills Explorations in FE and Training Sector.* Available at: https://www.et-foundation.co.uk/news/new-series-of-stories-about-digital-skills-explorations-in-fe-and-training-sector/?utm_campaign=1067390_Online%20CPD%20Courses%20Newsletter%20-%20%20Jan%2022&utm_medium=email&utm_source=The%20Education%20and%20Training%20Foundation&dm_i=4XJY,MVLQ,1IVSEI,2RUBI,1 (Accessed: 18th February 2022).

[62] Bowman, M. A., Vongkulluksn, V. W., Jiang, Z., & Xie, K. (2020). Teachers' exposure to professional development and the quality of their instructional technology use: The mediating role of teachers' value and ability beliefs. *Journal of Research on Technology in Education*, 1-17. https://doi.org/10.1080/15391523.2020.1830895

[63] Xie, K., Nelson, M. J., Cheng, S. L., & Jiang, Z. (2021). Examining changes in teachers' perceptions of external and internal barriers in their integration of educational digital resources in K-12 classrooms. *Journal of Research on Technology in Education*, 1-26. https://doi.org/10.1080/15391523.2021.1951404

[64] Naace. (2021). Self Review Framework https://www.naace.co.uk/naace-srf-guidance.html

and beliefs. However, the authors did find that as teachers perceived a reduction in context barriers including **leaders setting a vision for EdTech,** the quality of professional development was correlated with more positive attitudes and technology adoption (although it was not statistically significant). Strategic leadership of EdTech, including a **digital strategy** for an education setting was also cited in guidance literature as critical to successful implementation.[65,66] It was said to be important that the strategy was financially sound and aligned with the wider development plan for a setting.

The importance of **school culture** was cited in a literature review of the factors affecting primary teachers' use of digital technology.[67] A school culture that supported technology implementation and integration was described as one that empowered teachers to work collaboratively and innovatively on technology focused projects. When teachers felt respected and valued for their work, they were more motivated to use technology. The availability of digitally competent leaders and technical help when required, was another aspect of a school culture that fostered greater technology integration.

Although not sufficient in isolation, a strong **infrastructure** for technology integration and use was said to be critical to the successful implemenation of EdTech. Table 13 outlines how the DigCompOrg Framework[68] sets out the relevant considerations and activities required to ensure a more robust infrastructure.

[65] Anderson, M., & Kingsley, A. (2021). *A guide to creating a digital strategy in education*. Available at: https://www.netsupportsoftware.com/webresources/brochures/Digital_Strategy_Guide_v3.pdf (Accessed: 24th January 2022).
[66] European Commission. (2015). DigCompOrg Framework. Available at: https://ec.europa.eu/jrc/en/digcomporg/framework. (Accessed 12th January 2022).
[67] Spiteri, M., & Chang Rundgren, S. N. (2020). Literature review on the factors affecting primary teachers' use of digital technology. *Technology, Knowledge and Learning*, *25*(1), 115-128. https://doi.org/10.1007/s10758-018-9376-x
[68] European Commission. (2015). DigCompOrg Framework. Available at: file:///C:/Users/User/Downloads/jrc98209_r_digcomporg_final.pdf (Accessed 12th January 2022).

Table 13: DigCompOrg Framework - Infrastructure

Activity	Key considerations
Physical and virtual learning spaces are designed for digital-age learning	• Physical learning spaces (such as classrooms) optimise the use of digital-age learning. • Virtual learning spaces that optimise learning.
The digital infrastructure is planned and managed	• An Acceptable Usage Policy is in place. • Pedagogical and technical expertise informs investments in digital technologies. • A range of digital learning technologies supports anytime/anyplace learning. • Bring Your Own Device (BYOD) approaches are supported. • Risks relating to inequality and digital inclusion are addressed. • Technical and user support is evident. • Assistive technologies address special needs. • Measures to protect privacy, confidentiality and safety are clear. • Effective procurement planning is evident. • An operational plan for core ICT backbone and services is in place.

Finally, one study did use a secondary analysis of the International Computer and Information Literacy Study (IEA-ICILS 2018)[69] to investigate whether it was possible to identify what the authors described as organisationally resilient schools in computer and information literacy (CIL) after controlling for the social and economic circumstances of a context.[70] The authors used school level factors (availability of technology in school, teacher attitudes towards the potential of EdTech and teaching and learning, and teachers' levels of self-efficacy) and process factors (frequency of ICT use in school, the role of fostering learners' CIL in school, and the extent of teacher cooperation in using EdTech to improve learning), to evaluate the schools' performance. Thus, the study

[69] https://www.iea.nl/studies/iea/icils/2018 (14 countries, 2225 schools & 45,562 teachers. England or the UK is not a participating country. Learners (Year 8) from the sample complete a computer-based assessment to evaluate learners' CIL as well as school contextual data).
[70] Drossel, K., Eickelmann, B., & Vennemann, M. (2020). Schools overcoming the digital divide: In depth analyses towards organizational resilience in the computer and information literacy domain. *Large-scale Assessments in Education*, *8*(1), 1-19.

brought together teacher and context related factors for successful learner outcomes. The results showed that across the fourteen international educational systems that contribute to the database, just over five per cent of the schools (N=2,225) could be identified as organisationally resilient. In these schools, despite challenging social and economic circumstances, the learners acquired above-average scores in computer and information literacy.

Overview of the impact of EdTech

The main purpose of the rapid literature review was to contribute to a better understanding of how new technology is implemented and embedded in schools and colleges. A full evidence review of the impact of EdTech was beyond the scope of the project. Nevertheless, it has been possible to identify trends in the literature as the implementation review was conducted. The following section provides an overview of some of the key trends in the evidence as to the impact of EdTech based on the records that emerged during the searches. The analysis showed:

- Tentative emerging evidence for the impact of EdTech on learner achievement.
- Limited evidence of EdTech impact on learner engagement.
- Insufficient evidence to draw any conclusions of EdTech impact on teacher workload.
- Some emerging evidence of EdTech impact for communication with parents.
- Tentative, emerging evidence of assistive technology impact on learner achievement.
- Insufficient evidence to draw any conclusions as to whether some EdTech works better in different contexts such as type of educational setting, phase or level of digital maturity.

EdTech impact on learner engagement and achievement

The findings from four different types of review over the past two years **show tentative emerging evidence of EdTech impact on learner achievement, but primarily in the areas of mathematics, science and reading.** One meta-analysis (92 studies) of the potential of digital tools to enhance mathematics and science learning in secondary schools, found a positive effect on learning in 83% of the studies. The review included 16 studies that investigated the effects of digital tool use on learner attitudes as well as for learning. The overall findings showed that the use of digital tools had a positive effect on learner attitudes toward the subject taught (Effect Size = 0.45). Hence, secondary school learners who were taught using digital tools in science or mathematics had significantly more positive attitudes towards the subjects than learners who learned without the use of

digital tools.[71] Some of the reported effect sizes were very high and it should be noted that the test for heterogeneity by the authors showed that the effect sizes varied significantly between the studies indicating large differences in the samples which means the studies were not comparing 'like with like' and therefore some caution should be taken when interpreting the results.

Continuing with the theme of mathematics, a second review, consisting of randomised controlled trials and regression discontinuity studies across four categories of education technology: (i) access to technology, (ii) computer-assisted learning (CAL), (iii) technology-enabled behavioural interventions in education and (iv) online learning, found that CAL had shown to be quite effective in helping learners, particularly with mathematics. The authors highlighted two mathematics interventions in the United States. The first programme provides learners with immediate feedback on mathematics homework and was found to have an effect size of 0.18. The second, a more intensive software-based mathematics curriculum intervention, improved mathematics scores for seventh (ES=0.64) and eighth grade learners (ES=0.56).[72]

The third review to show emerging indicators of the positive impact of EdTech on learner achievement was a systematic review of **digitally delivered formative assessment**, based on 56 studies, 22 of which had stronger research designs and which informed the main findings. The analysis showed promising evidence that digitally delivered formative assessment could support the learning of mathematics and reading for primary aged learners.[73] The review could not find strong evidence for the effectiveness of digitally delivered formative assessment for writing, for other curriculum subjects or for secondary aged learners.

The fourth review (scoping) also investigated assessment and specifically how teachers use digital technologies for school-based assessment, and secondly, how these assessment-purposed digital technologies are used in teacher- and learner-centred pedagogies.[74] Overall, findings from the 43 peer reviewed papers and conference proceedings showed evidence of promise for the use of digital technologies for school-based assessment. The most reported use of digital technologies in assessment was the automated marking of learner work, most commonly multiple-choice, short and long text-

[71] Hillmayr, D., Ziernwald, L., Reinhold, F., Hofer, S. I., & Reiss, K. M. (2020). The potential of digital tools to enhance mathematics and science learning in secondary schools: A context-specific meta-analysis. *Computers & Education*, *153*, 103897. https://doi.org/10.1016/j.compedu.2020.103897
[72] Escueta, M., Nickow, A. J., Oreopoulos, P., & Quan, V. (2020). Upgrading education with technology: Insights from experimental research. *Journal of Economic Literature*, *58*(4), 897-996. DOI: 10.1257/jel.20191507.
[73] See, B. H., Gorard, S., Lu, B., Dong, L., & Siddiqui, N. (2021). Is technology always helpful?: A critical review of the impact on learning outcomes of education technology in supporting formative assessment in schools. *Research Papers in Education*, 1-33. https://doi.org/10.1080/02671522.2021.1907778
[74] Blundell, C. N. (2021). Teacher use of digital technologies for school-based assessment: a scoping review. *Assessment in Education: Principles, Policy & Practice*, *28*(3), 279-300. https://doi.org/10.1080/0969594X.2021.1929828

based responses to a range of question types. Depending on the technology used, ePortfolios also supported teacher activity in assessment. They allowed for annotating learner work in a range of ways (writing, drawing and audio recordings) for feedback purposes, tracking progress over time and creating a context for discussion with learners. Parents could also engage with their child's learning through the ePortfolio.

A fifth (scoping) review investigated the **potential of technology to facilitate self-directed learning** in children up to eighteen years.[75] Findings from 14 studies showed some potential for digital technology to support learners in self-directed learning, particularly as a means of sourcing information especially if a learner was unable to access other forms of support. However, where there was less progress, a common thread through the studies was that learners often lacked the digital competence to use the technology effectively and often had to seek help.

EdTech and teacher workload

The searches found only one record, a scoping review of 43 papers that investigated teacher use of digital technologies for assessment, that also referred to the relationship between **EdTech and teacher workload related factors.**[76] Some of the benefits of using these approaches included: saving time in not having to mark learners' work; immediate availability of learner achievement data (for learners and teachers) to track learner progress; for teachers to use this information for future lesson planning and provide individualised learner support if required.

EdTech and parental engagement

The searches found three records that met the review criteria and investigated **parental engagement with and the impact of EdTech**. One of the records was a systematic review, the second an international survey (that included parents from the United Kingdom) and the third a qualitative study with 15 mothers of primary aged learners in England. All three studies found some evidence of promise for using digital communication such as the telephone, text messages, emails and websites to support parental engagement with their child's education. There is as yet, no *causal* evidence that such digital communications are effective in enhancing parental involvement *and* improving learner outcomes.

[75] Morris, T. H., & Rohs, M. (2021). The potential for digital technology to support self-directed learning in formal education of children: A scoping review. *Interactive learning environments*, 1-14. https://doi.org/10.1080/10494820.2020.1870501

[76] Blundell, C. N. (2021). Teacher use of digital technologies for school-based assessment: a scoping review. *Assessment in Education: Principles, Policy & Practice*, *28*(3), 279-300. https://doi.org/10.1080/0969594X.2021.1929828

In a systematic review of 29 studies, 18 concerned the use of digital communication to support parental engagement.[77] Overall, the review found some evidence of association (small effect size) for the use of mobile phone apps in providing parents with regular updates on their children's school performance and homework requirements and an improvement in their children's academic attainment in mathematics. The review also found that digital communication has the potential to improve school attendance and reduce absenteeism for older learners and that learners with lower prior attainment benefitted most from digital home-school communication. Five of the papers in the review addressed the use of home computers with parental monitoring. The findings are currently inconclusive, and the authors noted that many of the studies were dated with two from the early 1990s. Finally, six studies in the review reported the effects of other technology devices (online homework tools and digital media such as television programmes and videos) and found very little robust evidence of a link with improved learner attainment. Again, the authors note study methodology challenges such as small samples and a lack of comparison groups.

The potential of digital communication to strengthen parental engagement with their child's education was also found in a recent international survey of parents.[78] This involved data collected from an online survey of 4,658 parents (from 23 countries involved in the International COVID19 Impact on Parental Engagement Study) of children between six and 16 years old. The study found a positive and statistically significant relationship (association not causal) ($p < 0.001$) between parental engagement with technology and parents being more engaged with their child's education.

Future practice and research will need to consider the barriers experienced by parents when using digital communication and different forms of EdTech. A qualitative study consisting of interviews with fifteen mothers of primary school aged children in England, highlighted some of the challenges experienced by parents such as the time needed to manage the increased communications and often having to use many different technology platforms.[79] Moreover, many parents in the international survey reported that when school technology was perceived as being complex to use, parents were less likely to engage with their children's learning ($p < 0.001$).[80]

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[77] See, B. H., Gorard, S., El-Soufi, N., Lu, B., Siddiqui, N., & Dong, L. (2020). A systematic review of the impact of technology-mediated parental engagement on learner outcomes. *Educational Research and Evaluation*, *26*(3-4), 150-181. https://doi.org/10.1080/02671522.2021.1907778

[78] Osorio-Saez, E. M., Eryilmaz, N., & Sandoval-Hernandez, A. (2021). Parents' Acceptance of Educational Technology: Lessons From Around the World. *Frontiers in Psychology*, *12*. https://dx.doi.org/10.3389%2Ffpsyg.2021.719430

[79] Head, E. (2020). Digital technologies and parental involvement in education: the experiences of mothers of primary school-aged children. *British Journal of Sociology of Education*, *41*(5), 593-607. https://doi.org/10.1080/01425692.2020.1776594

[80] Osorio-Saez, E. M., Eryilmaz, N., & Sandoval-Hernandez, A. (2021). Parents' Acceptance of Educational Technology: Lessons From Around the World. *Frontiers in Psychology*, *12*. https://dx.doi.org/10.3389%2Ffpsyg.2021.719430

Assistive technology

The searches found five records which met the review criteria and that examined the impact of **assistive technology.** Three of the records were rapid literature reviews, a fourth was a qualitative study of secondary learners with visual impairment and the fifth was a website of assistive technology resources for education professionals. Overall, the review findings point to assistive technology being under-utilised in schools and colleges and the efficacy evidence base is at a very early stage requiring systematic large-scale studies.

A recent rapid review of assistive technology based on 968 records found moderate or strong evidence for a small number of assistive technology interventions.[81] Evidence appears strongest for assistive technology with a focus on speech, language, and communication disabilities and the use of communication systems such as augmentative alternative communication (AAC) devices. Recent literature reviews that have examined assistive technology for individual special educational needs (SEN) including specific learning difficulties such as dyslexia and dyscalculia, and disabilities such as, hearing impairment, have similar findings. A rapid review of assistive technology and specific learning difficulties (SpLDs) reported some evidence of EdTech supporting learning such as mobile devices and tablets increasing learner motivation, improving learner behaviour, facilitating self-directed learning and mathematical skills.[82] Here too however, authors point to the need for research with research designs that adopt, for example, large scale experimental approaches. A rapid review (peer reviewed) of 20 records that met inclusion criteria of assistive technology and hearing impairment found just seven studies of promise on the impact of assistive hearing technology on educational performance.[83] The searches found one empirical study (that met this review's inclusion criteria) which conducted semi-structured interviews with seven learners with visual impairments (VI) in three secondary schools in England. It examined their accounts of their activities and experiences of EdTech. The perspectives of the learners varied reporting some benefits of EdTech such as tablets for learning but also, participants experienced challenges including stigma and the negative impact of teachers' challenges with implementing inclusive digital pedagogy.[84] Finally, to support schools in the increased and effective use

[81] Edyburn, D. (2020). Rapid literature review on assistive technology in education. Research Report. London, UK: Department for Education. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/937381/UKAT_FinalReport_082520.pdf (Accessed: 21st January 2022).
[82] Carroll J., Ross H., Luckin R., Blake C., Kent C., Clark-Wilson A., Laurillard D., & Butterworth, B. (2020). Current Understanding, Support Systems, and Technology-led Interventions for Specific Learning Difficulties. London, UK: Government Office for Science. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/926052/specific-learning-difficulties-spld-cst-report.pdf (Accessed: 28th January 2022).
[83] Bell, D., & Foiret, J. (2020). A rapid review of the effect of assistive technology on the educational performance of learners with impaired hearing. *Disability and Rehabilitation: Assistive Technology*, *15*(7), 838-843.
[84] Cranmer, S. (2020). Disabled children's evolving digital use practices to support formal learning. A missed opportunity for inclusion. *British journal of educational technology*, *51*(2), 315-330.

of assistive technology, nasen has published an assistive technology resource bank for education professionals which includes a self-evaluation and action planning framework.[85]

Summary

This rapid literature review found limited evidence, that met search criteria, often in the form of national and international framework guidance, literature reviews and some international empirical studies to address the research questions.

When selecting EdTech, key considerations include the need for identifying the specific need and/or priority that the EdTech product will address, an informed pedagogical understanding of how EdTech can effectively enhance learner learning and the importance of interrogating the evidence base available for individual EdTech products. The main barriers to the effective implementation comprised of context related barriers such as leadership and technology infrastructure, education professionals' lack of EdTech knowledge, and skills and their attitudes to EdTech such as feelings of confidence and self-efficacy. The review found the main factors to support the effective implementation of EdTech to include training, development and learning opportunities for education professionals and context related factors including leadership, school culture and technology infrastructure. Finally, there is some emerging, albeit very tentative evidence of how EdTech, to date, has had an impact on learner achievement and engagement for subjects such as mathematics, science and reading, particularly in the primary phase. What is striking are the gaps in the empirical evidence base both nationally and internationally. These included gaps in empirical studies that investigated:

- The actual *process* of implementation of EdTech in schools and/or colleges.
- To what extent schools and colleges are using the various digital technology frameworks available to inform the development of EdTech strategy and practice.
- Empirically tested models to assess digital maturity.
- The implementation and impact of EdTech for different phases, there was, for example, very little research in the further education sector.
- The implementation of EdTech that is not pedagogy related, for example, school management information systems.

[85] nasen. (2022). Assistive Technology Resource Bank. Available at: http://extension.nasen.org.uk/assistive-technology (Accessed: 2nd February 2022).

More technology to support teaching and learning does not equate to better outcomes for learners.[86] Therefore, addressing these evidence gaps will help inform schools and colleges as to more efficacious practice with respect to their EdTech strategy and ultimately to improved learner outcomes.

[86] Vincent-Lancrin, S. (2021). Frontiers of smart education technology: Opportunities and challenges. *OECD Digital Education Outlook 2021 Pushing the Frontiers with Artificial Intelligence, Blockchain and Robots: Pushing the Frontiers with Artificial Intelligence, Blockchain and Robots*, 19. Available at: https://www.oecd-ilibrary.org/sites/589b283f-en/index.html?itemId=/content/publication/589b283f-en (Accessed: 14th January 2022).

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Bowman, M. A., Vongkulluksn, V. W., Jiang, Z., & Xie, K. (2020). Teachers' exposure to professional development and the quality of their instructional technology use: The mediating role of teachers' value and ability beliefs. *Journal of Research on Technology in Education*, 1-17. https://doi.org/10.1080/15391523.2020.1830895

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See, B. H., Gorard, S., El-Soufi, N., Lu, B., Siddiqui, N., & Dong, L. (2020). A systematic review of the impact of technology-mediated parental engagement on learner outcomes. *Educational Research and Evaluation*, *26*(3-4), 150-181. https://doi.org/10.1080/02671522.2021.1907778

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Appendix 4: Matrix of literature review inclusion/exclusion criteria, databases and websites

Table 14: Literature search criteria

Inclusion and exclusion criteria	Websites	Databases
Inclusion England/UK/ and (International if required) 2020-2022 Search term within abstract Journal article, government report, research guide, government document English language Primary, secondary and further education Exclusion Remote learning Online learning	EdTech Impact EdTech Evidence Group Education & Training Foundation AOC LendED UCL Educate Edtechnology.co.uk OECD World Bank DfE Ofsted Chartered College of Teaching Devolved Education Departments General Teaching Council for Scotland Google TES	ProQuest[87] Emerald Scopus JSTOR Web of Science ERIC Education Administration Social Science Citation index Global Health MEDLINE Public Health Database ScienceDirect PubMED Psyc.INFO Directory of Open Access Journals Google Scholar Google

[87] ProQuest Central is the largest multidisciplinary database with over 11,000 titles, and over 8,000 titles in full-text. Over 160 subject areas are covered including business, education, economics, health and medical, news and world affairs, technology, social sciences. https://about.proquest.com/libraries/.

Appendix 5: Literature review search terms matrix

Searches comprised a combination of terms, initially with one from column A, and then A and B and then A, B and C.

Table 15: Search terms matrix

A +	B +	C
technology*	school*	implementation
digital technology	further education	embed*
EdTech	college*	use
education* technology	primary	evaluation
assistive technology	secondary	selection
		procurement
		choose
		sourc*
		barriers
		administration
		timetabl*
		finance
		pupil/learner data
		assessment
		parent*
		training
		continuing professional development
		pastoral
		teacher

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