The Impact of Digital Technology on Learning: A Summary for the Education Endowment Foundation

Executive Summary

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Overview
This review presents a synthesis of the quantitative evidence on the impact of digital technology on the attainment of school-age pupils. Its purpose is to identify key implications for future investment in digital technologies for learning in schools.

Digital technology is embedded in our society. The focus of technologies in teaching and learning has shifted from whether or not to use them, to understanding which technologies can be used for what specific educational purposes and to investigating how they can best be applied in a range of educational contexts.

Overall, the reviewed studies consistently show that technology is associated with moderate learning gains. However, there are considerable variations in impact. Evidence suggests that, to be effective, technology: must be underpinned by sounds pedagogy; should be adopted for a specific reason, rather than simply following a trend; should be used to supplement other teaching, rather than replace more traditional approaches; and should be used alongside high quality training for teachers. Taken together, these findings imply that careful thought is needed when considering how to use technology to best effect.

Methodological Note
This review summarises the research evidence contained in meta-analyses to identify patterns of impact in the accumulating research about the effects of technology on learning, and to identify the extent of the possible impact of technology on learning. A systematic search revealed 48 studies which synthesised primary research studies of the impact of technology on the attainment of school age learners (5-18 year olds). Whilst this presents only a partial and retrospective view of such impact, it is the only approach to allow a systematic comparison of a large number of studies with an estimate of the extent of the effects on learning.

It is also important to note that the review focuses on studies which include valid comparison groups of pupils (known as experimental or quasi-experimental designs) to measure the impact of technology. Experimental studies can be contrasted with case studies, or correlational research, which simply compare the outcomes of schools that use particular types of technology with those that do not. Given that it seems probable that more effective schools and teachers are likely to use technology more effectively than other schools, these kinds of studies are not able to determine a causal link between the use of technology and higher attainment.

It’s the pedagogy, not technology
From the range of impacts identified in this review, it is clear technology alone does not make a difference to learning. Rather, how well the technology is used to support teaching and learning is the key determinant of its impact. There is no doubt that technology engages and motivates young people. However, this benefit is only an advantage for learning if the activity is effectively aligned with clear learning objectives. The crucial lesson emerging from the research is that it is the pedagogy underpinning technology use which is important: the how rather than the what. The challenge is to ensure that technology is used to enable and to advance effective teaching and learning practices.

The use of technology needs to be informed by context and research
When considering how technology can be used to improve learning, it is essential to determine the problem or priority the new technology aims to solve or advance prior to its introduction in the classroom, and to consider what the new technology will replace.

Technology is not introduced into a vacuum. When teachers choose to adopt technology, they often do so as part of a process of inquiry, replacing or displacing some problematic practice. When technology is adopted for its own sake, it replaces or displaces prior teaching and learning activities which may have been as, or even more, effective. Therefore, care should be taken to ensure that technology replaces practices shown to be less effective, and is integrated into a more effective or more efficient learning context. There is extensive research
about what effective teaching and learning looks like, and this should be used, alongside context-specific information, to assess how technology can be used effectively.

For example, will technology help learners gain access to more learning content? Will technology support more effective feedback from teachers or peers? Will it promote better self-management by learners themselves? Or will the technology itself provide feedback?

Further key findings from the research:

- Collaborative use of technology (in pairs or small groups) is usually more effective than individual use, though some pupils, especially younger children, may need guidance in how to collaborate effectively and responsibly.

- Technology can be powerful as a short but focused intervention to improve learning, particularly when there is regular and frequent use (about three times a week) over the course of about a term (5 - 10 weeks). Sustained use over a longer period is usually less effective at improving attainment.

- Remedial and tutorial use of technology can be particularly practical for providing intensive support to lower attaining pupils, those with special educational needs or those from disadvantaged backgrounds.

- Technology is best used as a supplement to normal teaching rather than as a replacement for it.

- Tested gains in attainment tend to be greater in mathematics and science (compared with literacy for example) though this is also a more general finding in meta-analysis and may be at least partly an artefact of the measurement process. In literacy, the impact tends to be greater in writing interventions compared with reading or spelling.

- Training and professional development for teachers is an important component of successful approaches. At least a full day's training or on-going professional inquiry-based approaches appear to be the most advantageous. Such support should go beyond the teaching of skills in technology, and focus on the successful pedagogical use of technology to support teaching and learning aims.

Overall, the implication is that technology is a catalyst for change, rather than a solution in its own right. The question is how technology can bring about improvement and make teaching and learning practices more efficient or effective. Focusing on the change (and the process of change) in terms of learning is essential in supporting effective use.

Challenges
Though there is often a keen interest in emerging technologies, this enthusiasm is not always accompanied by evidence of impact. The research highlights some challenges and general concerns, including:

- **Identifying the impact of one-to-one provision of technology.**
  One-to-one provision of technology requires the teacher to manage its use effectively, as well as to give effective feedback and support in terms of using successful learning strategies, such as planning and organising collaborative activities. It can also be a challenge for learners in terms of their individual skills and in terms of the risk of distraction. This may be particularly pertinent to the introduction of iPads and other tablets in the classroom.

- **The challenge of using the internet as an educational resource.**
  The world wide web is undoubtedly a fantastic educational resource. However, allowing learners to access the internet without guidance is a little like sending them into the British Library and expecting them to successfully seek out resources to support their learning. Capturing the potential benefit of the internet has not proved straightforward to date.
The growth of e-learning and lack of evidence of beneficial impact on learning.
Much of the published research about e-learning relates to the higher education sector, and even here there is little evidence of positive impact on students’ learning. It is certainly the case that well-motivated and experienced learners can learn very effectively through e-learning. However, it is also clear that without the necessary motivation, skills and experience e-learning may well not be so successful.

Enthusiasm for gaming and games-based approaches, despite the lack of evidence of impact in terms of attainment.
Children and young people are often highly motivated by computer games, however, the challenge is to ensure that the learning can be achieved outside of the gaming environment. There is a risk that games appear to be effective simply because pupils continually improve at the game. Although learners may be learning new skills and developing their capabilities, the challenge is to link this to their wider learning objectives.

Concerns about the detrimental impact on health and well-being of sustained use of computer technology, particularly for younger learners.
These concerns relate to physical issues (such as posture and eyesight); health concerns (such as physical fitness and obesity) and social issues (social isolation or addiction). It is therefore necessary to consider using technologies in ways which promote rather than hinder physical and mental well-being.

The danger of solutions in search of problems
The majority of those who jump on the technology bandwagon and adopt it in the classroom, don’t necessarily know what to do with the equipment in order to get the best from it educationally. Early adopters of technology may chose a particular technology without due consideration for a specific learning or teaching focus. This is a key challenge for proponents of technological solutions in education.

Recommendations
As a result of these findings, those interested in using digital technology to improve teaching and learning should bear in mind some key recommendations:

1. The rationale for the impact of technology on learning needs to be clear:
   - Will learners work more efficiently, more effectively, more intensively? Will the technology help them to learn for longer, more deeply, more productively? Or will the teacher be able to support learners more efficiently or more effectively?
   - Will it help learners gain access to learning content, to teachers or to peers? Will the technology itself provide feedback or will it support more effective feedback from others, or better self-management by learners themselves?

2. Technology should support collaboration and effective interaction for learning:
   - The use of digital technologies is usually more productive when it supports collaboration and interaction, particularly collaborative use by learners or when teachers use it to support discussion, interaction and feedback.

3. Teachers and/or learners should be supported in developing their use of digital and computer technologies to ensure it improves learning:
   - Training for teachers (and for learners), when it is offered, usually focuses on technical skills in using the equipment. This is not usually sufficient to support teachers and pupils in getting the best from technology in terms of their learning. On-going professional development and support to evaluate the impact on learning is likely to be required.

4. Identify what learners and teachers will stop doing:
   - The use of digital technologies is usually more successful as a supplement rather than as a replacement for usual teaching. It is therefore important to identify carefully what it will replace or how the technology activities will be additional to what learners would normally experience.
Postscript: Some contemporary myths about digital technology use in education

Myth 1: New technologies are being developed all the time, the past history of the impact of technology is irrelevant to what we have now or will be available tomorrow.
After more than fifty years of digital technology use in education this argument is now wearing a bit thin. We need a clear rationale for why we think the introduction of (yet another) new technology will be more effective than the last one. The introduction of technology has consistently been shown to improve learning, the trouble is most things improve learning in schools when they are introduced, and technology is consistently just a little bit less effective than the average intervention.

Myth 2: Today’s children are digital natives and the ‘net’ generation – they learn differently from older people.
There are two issues with this myth. First, there is no evidence the human brain has evolved in the last 50 years, so our learning capacity remains as it was before digital technologies became so prevalent. It may be that young people have learned to focus their attention differently, but their cognitive capabilities are fundamentally the same as 30 years ago. Second, just because young people have grown up with technology it does not mean they are experts in its use for their own learning. Being an expert at playing Halo 5 requires different skills and knowledge from having an active Facebook account. Most young people are fluent in their use of some technologies, but none are expert at all of them.

Myth 3: Learning has changed now we have access to knowledge through the internet, today’s children don’t need to know stuff, they just need to know where to find it.
The web has certainly changed access to information, but it only becomes knowledge when it is used for a purpose. When this requires understanding and judgement, information alone is insufficient. Googling is great for answers to a pub quiz, but would you trust your doctor if she was only using Wikipedia? To be an expert in a field you also need experience of using the information and knowledge, so that you understand where to focus your attention and where new information will help you in making decisions and judgements. It is important to recognise the relevance or importance of different pieces of information. Easy access to information can help, but it is no substitute for experience, understanding and expertise.

Myth 4: Students are motivated by technology so they must learn better when they use it.
It is certainly true that most young people do enjoy using technology in schools to support their learning. However, the assumption that any increased motivation and engagement will automatically lead to better learning is false. It is possible that increased engagement or motivation may help increase the time learners spend on learning activities, or the intensity with which they concentrate or their commitment and determination to complete a task. However, it is only when this engagement can be harnessed for learning that there will be any academic benefit. There is another caveat here as the motivation in school may be partly because using technology is either novel in school, or simply a change from what they usually experience. It may not be the case that this motivation will be sustained over time.

Myth 5: The Everest Fallacy: we must use technology because it is there!
We should use some of the wide range of digital technologies that are available to us to support learning and teaching in schools, but this should be where they improve aspects of teaching and learning and help to prepare children and young people for their lives after school. The curriculum and the way in which pupils work and are assessed should reflect the society and culture they are preparing pupils to be a part of when they leave formal education. However the challenge is knowing which technology is the best to choose for use in schools and for what purposes and learning outcomes they should be employed.

Myth 6: The “More is Better” Fallacy
Enthusiasts assume that if a little technology is a good thing then a lot will be much better. The evidence does not support this assumption, for two reasons. First, large-scale international studies indicated very high use of technology – e.g. pupils using the internet more than four hours per day – is not linked with better learning. Second, the effect of technology and length of interventions indicate that more is clearly not always better. This suggests that there is an optimum level of technology which can support learning, too little and you don’t see the benefit, too much and the gains decline. A better notion might be the Goldilocks effect: it is about getting the amount of technology, and learners’ access to it “just right”.

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