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Summary

Research evidence about portable ICT can be found across most subject areas, and across all phases of education.

Key benefits

- General pupil learning gains derived from increased enthusiasm, motivation, confidence and a sense of ownership
- Greater integration into classroom use and across the curriculum compared to other forms of ICT
- Increased independence and self-initiated learning in pupils, and the extension of learning beyond the classroom.

Teachers can maximise the impact of portable ICT by:

- being confident in its use and undergoing training where necessary
- recognising and exploiting the advantages of portability
- using portable ICT in an integrated way in teaching and learning, alongside clear pedagogical approaches and learning goals.

What the research says about portable ICT devices in teaching and learning

This report is based on an analysis of available research about the use of portable information and communications technology (ICT) devices in teaching and learning. It summarises the key findings and suggests resources for further reading.

What is a portable ICT device?

For this analysis, a 'portable ICT device' is defined as a computer able to be carried by a person with reasonable ease with regard to its size and weight.

Further, it must be possible to use the device for periods of time without connection to a mains electricity supply. Most commonly, this means that the device uses batteries as an energy source (although many calculators now use solar power technology).

In this briefing, then, 'portable devices' is used to refer to the full spectrum of relatively light and compact machines.

This includes:

- multimedia notebook computers (often referred to as 'laptops')
- personal digital assistants (PDAs)
- tablet PCs
- hand-held computers
- palmtop computers
- data-logging devices
- programmable calculators.

Obviously, the more powerful and multi-faceted the machine, the more uses it can be put to. But to judge whether they have potential to enhance teaching and learning it is necessary to examine the available research evidence.

Key research evidence about portable ICT in teaching and learning

On the basis of Becta's analysis, portable ICT devices can have positive effects in the areas outlined below (there are references for further reading supplied alongside some of the findings).

About Becta's 'What the Research Says...' series

This series of briefing papers is designed in particular for teachers, ICT co-ordinators and school managers, in order to provide an initial idea of the available research evidence for the use of Information and Communications Technology (ICT) in schools and colleges. We welcome feedback and suggestions for further titles in the series (contact details can be found at the end of this briefing).

General benefits

- Portable ICT devices do not dominate in the same way desktop computers can, and may be more readily integrated into classroom use and across the curriculum with the minimum of disruption to existing practices (Moseley and Higgins, 1999)
- The use of notebook computers, together with wireless networking technology, allows ICT work to be done in the classroom, saving both space and the time needed to move to specially equipped ICT suites (Perry, 2002)
- Portability enables students to take work home to continue working, and this can foster greater feelings of ownership over work (Passey, 1999).

Benefits of use by students

- Gains in understanding and analytical skills, including improvements in reading comprehension (Lewin *et al.*, 2000)
- Development of writing skills (including spelling, grammar, punctuation, editing and re-drafting), also fluency, originality and elaboration (Lewin *et al.*, 2000)
- Increased motivation, organisation skills and responsibility amongst pupils (Perry, 2003)
- Encouragement of independent and active learning, and self-responsibility for learning (Passey, 1999).

Benefits of use by teachers

- Gains in ICT literacy skills, confidence and enthusiasm (Harrison *et al.*, 1998)
- Easier planning and preparation of lessons and designing materials
- Greater ability and confidence to support students' learning with ICT
- Access to up-to-date pupil and school data, any time and anywhere (Perry, 2003)
- Increased efficiency and accuracy of day-to-day registration of pupils (Perry, 2003)
- Enhancement of professional image projected to colleagues.

Benefits for parents

- Increased involvement in education for parents and, in some cases, improved self-esteem (Hennessy, 1998; National Literacy Association, 1996)
- Increased knowledge of children's learning and capabilities, owing to increase in learning activity being situated in the home.

However, these benefits do not occur universally. A range of factors appears to influence whether these benefits will be realised.

Factors for effective use

- Both teachers and students need sufficient time for familiarisation with the devices
- There needs to be ready access to technically competent staff, to allow devices to be used to their full potential (Perry, 2003)
- Use must be supported by clear pedagogical approaches and identification of specific learning goals
- Time needs to be invested in 'consulting' regarding portable ICT initiatives with teachers and parents (Passey, 1999)
- Comprehensive information must be available regarding the technological and educational capacities of the devices
- Teachers must be directly involved in decisions on planning and curriculum use (Moseley and Higgins, 1999)
- Teachers need to feel ownership of portable devices, and have opportunities to develop ICT competence and confidence, so they can support their use by students both pedagogically and technically (Harrison *et al.*, 1998)

Safety and security should also be key concerns. Issues such as the weight and robustness of machines, and ergonomic factors relating to the size and design of devices, which can affect user posture and operational use, require continual attention.

Portable ICT in practice

Portable ICT has brought about great benefits for one sixth form pupil. Laura had a stroke which left her right arm affected, and this meant she needed support in recording her work. Laura wanted this support to be under her control, so the ideal solution was for her to use speech recognition software.

Laura was referred to Becta's Communication Aids Project (CAP), which provides equipment to pupils who have difficulty in communicating with others, and as a result she was provided with a notebook computer with speech recognition software installed. The portability of the equipment means that Laura can make

decisions about where is the best place to use it. For example, she frequently uses it at home as the quieter environment results in less distraction for her, and also the software: "I want to settle to the job I have to do with it. I compose my thoughts and I make outline notes usually and then I get down to dictation in the best

environment possible where I will get minimum disturbance."

More details of this and other case studies which explain how pupils benefit from CAP equipment can be found on the CAP website: <http://cap.becta.org.uk/>

Explanation of findings

As with any form of ICT, positive impacts relating to portable ICT devices depend on the ways in which they are used. Improvements in cognitive capacity, creative or critical thinking will inevitably be reliant on the capacity of teachers and students to use ICT as an effective pedagogical tool in the pursuit of wider learning objectives.

Implications for teaching from the widespread use of portable ICT

There is evidence that the use of portable devices can help increase both collaborative learning and communication, and independent learning amongst students, owing to the mobility and capacity of the machines (Passey, 1999). They can help 'normalise' the use of ICT in learning, that is to say, the better integration of computing technology into lessons as 'just another' tool for learning.

The use of portables can also have a significant impact on classroom organisation and teaching style. Teachers can act more as facilitators and peer tutoring can become more commonplace – if teachers and students are open to and ready for, these developments.

The importance of ownership and personalisation

Student 'ownership' of portable ICT devices opens up possibilities for the use of ICT and access to educational materials across the curriculum, in the field, and in the home. Some of the most pronounced benefits have been gained in schemes that have given students portable devices for their own use.

Accessibility, flexibility and frequency of use in and out of school are important factors for success (Harrison *et al.*, 1998; Hennessy, 1998; Thomas and Pettigrew, 1999). Evidence suggests that portable devices increases the amount and quality of homework undertaken and the range of subjects for which ICT is used.

Similarly, unlimited access to ICT via the provision of portable devices can help teachers become suitably confident and experienced with ICT, so further

enabling them to maximise benefits arising from their students' use of technology. The most significant and consistently positive impact of schemes involving portable devices appears to occur when there is teacher 'ownership'. More effective implementation and use of ICT in the classroom occurs when teachers have the time to develop their own classroom - and subject-based skills with ICT in a range of contexts and at their own pace, rather than the technology feeling like an imposition. Encouragement, peer support, the availability of equipment and time for private experimentation are important for both students and teachers (Hennessy, 1998).

There is also evidence that 'ownership' of portable devices increases students' motivation and responsibility to extents that do not necessarily derive from the use of PCs and shared school-based hardware (National Literacy Association, 1996). Attendance and punctuality amongst students can increase as a result. Allowing children personal ownership of equipment can bring benefits to disadvantaged pupils who would otherwise have no access to ICT at home (Perry, 2003). In some cases, individual ownership is seen to be influential in heightening home-school links and increasing parental participation (Merchant and Monteith, 1997). This appears to be more evident when parents buy, or are loaned, portable devices for exclusive use by their children. However, personal ownership and home use of portable equipment brings about concerns for security and the safety of children carrying such devices (Perry, 2003).

Key areas for further research

The potential mobility of learning that may result from portable devices being given to students for their own use, and that can be taken out of the school or traditional learning context, raises a host of issues. Many have yet to be fully appreciated and addressed.

A further area for future enquiry might be to isolate and more adequately measure students' motivation gains or decreases as a result of the introduction of portable devices and then compare the impacts along variables such as gender. Tablet PCs are a new technology which schools are only just beginning to use. As a result, little research into their impact on education has been carried out to date, but this is an area which will need to be investigated in the future.

About the research literature

A significant proportion of the evaluation studies identified to date concerning the use of notebook computers result from government initiatives which introduced portables into schools. Many of these studies are small scale and qualitative, relate to primary rather than secondary level, and focus on English, mathematics and science.

Studies into the impact of portable devices on teaching and learning have continued and expanded to cover a wider range of applications and subject areas. While more than 70 per cent of studies relate to the core subjects of English, mathematics and science, Becta's survey of the research literature found studies on the use of portable ICT in the following subject areas:

- English/Literacy
- Mathematics/Numeracy
- Humanities
- Science
- Modern Foreign Languages
- ICT Literacy
- Design and Technology
- Special Education
- Physical Education.

The bulk of the studies concern notebook computers. Devices with more specific uses, such as word processors, graphical calculators and PDAs have been evaluated in fewer studies, and these tend to be more recent, dating from 1997 onwards.

Key questions for schools

- How can you ensure that students, teachers and parents are as involved as possible in the planning of portable ICT initiatives?
- Will you be able to provide the training and technical support that may be necessary for the effective teacher and student use of portable ICT?
- Have you considered all of the safety and security issues surrounding the use of portable ICT?

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Becta's ICT Research Network

If you're interested in research on the use of ICT in education, you can join Becta's ICT Research Network.

The ICT Research Network seeks to encourage the exchange of information in order to inform the national agenda and professional practice.

Membership is free and is open to:

- teachers
- ICT co-ordinators
- ICT advisors
- school managers
- researchers
- policy makers
- research sponsors
- industry.

The Network provides them with an opportunity to:

- exchange information on current research
- develop partnerships
- discuss priorities for further investigation
- focus research on issues of importance to practitioners and policy makers.

They can do this via:

- an email discussion list
- publications
- conferences and events.

More information on Becta's ICT Research Network can be found at www.becta.org.uk/research/ictrn

Alternatively, email:

ictrn@becta.org.uk or write to:

Michael Harris, ICT Research Network, Becta, Millburn Hill Road, Science Park, Coventry CV4 7JJ

www.becta.org.uk/research

About Becta

Becta is the Government's lead agency for information and communications technology (ICT) in education and supports UK Government, national organisations, schools and colleges in the use and development of ICT in education to raise standards, widen access, improve skills and encourage effective management.

About the ICT in Schools Programme

The ICT in Schools Programme is the Government's key initiative to stimulate and support the use of information and communications technology (ICT) to improve standards and to encourage new ways of teaching and learning. The enormous potential of ICT means that for the first time it is becoming possible for each child to be educated in a way and at a pace which suits them, recognising that each is different, with different abilities, interests and needs. The challenge over the next four years will be to successfully embed ICT in every facet of teaching and learning where it can directly impact on raising standards of attainment. A vision for the future of ICT in schools can be found in the paper *Fulfilling the Potential – Transforming Teaching and Learning through ICT in Schools*, available on the DfES ICT in Schools website [<http://www.dfes.gov.uk/ictinschools/publications/>].

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