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Summary

There is limited research evidence about the effective use of ICT in the teaching and learning of geography in schools. However, some studies and reports have identified key educational benefits and suggested various ways ICT can enhance the geography curriculum.

Key benefits of using ICT in geography:

- ICT can make geography more authentic and relevant
- ICT allows more time for observation, discussion and analysis
- Using ICT increases opportunities for communication and collaboration

Teachers can maximise the impact of using ICT in geography by:

- being clear as to how the use of ICT will support lesson objectives
- using ICT as a tool, not just as an information resource
- giving pupils greater autonomy in their geographical investigations
- incorporating the use of portable ICT equipment in teaching.

How ICT contributes to learning and teaching in geography

What the research says about using ICT in geography

This report is based on an analysis of current research about the use of ICT in the learning and teaching of geography. It summarises the key findings and suggests resources for further reading.

Geography provides a rich and varied context for the use of new technologies to enhance both learning in the subject and to reinforce existing ICT skills (Ofsted, 2004a). ICT can help pupils investigate, organise, edit and present geographical information in many different ways.

In geography, ICT can help pupils to:

- enhance geographical knowledge and improve geographical enquiry skills
- develop graphical, statistical and spatial analysis skills
- develop mapping skills
- experience alternative images of people, places and environments and how environments change
- simulate or model geographical systems and environments
- communicate with other pupils in contrasting localities by email, webcams and video conferencing
- improve the appearance of work by enhancing presentation
- increase awareness of the impact of ICT in the changing world.

This report considers not just the technologies themselves but also the pedagogical implications and the support necessary to enhance learning and teaching of geography.

Key Research Evidence about using ICT in geography

On the basis of Becta's analysis, ICT can have positive effects on the learning and teaching of geography in the areas outlined below. There are references for further reading supplied alongside some of the findings.

Benefits for pupils

- Geographical Information Systems (GIS) simplify many geographical concepts and present large amounts of non-sequentially related data in simple and readily accessible formats, allowing pupils to concentrate on interpreting and analysing data (West, 1999)
- Using GIS software enhances spatial awareness and decision-making skills (Audet and Paris, 1997; Taylor, 2003; West, 1999)
- Using simulations and modelling tools can lead to enhanced understanding of geographical topics such as erosion and agriculture (Cox and Abbott, 2003)
- ICT enables higher level thinking skills, especially for pupils using GIS (West, 1999)
- Using digital photography in a classroom mapping activity helps develop recall, reflection and self-assessment skills (Storey, 2002)
- Interactive ICT such as email enables the exploration of a sense of place, through communicating with people as well as through pictorial features (Storey, 2002)
- Using emails alongside postcards to make comparisons of places helps pupils to gain a better appreciation of other cultures (Storey, 2002)

Benefits for teachers

- Using GIS can significantly enhance geography teaching and learning environments (Audet and Paris, 1997)
- Digital photography allows teachers to record pupils' work undertaken on field trips and other learning outcomes not readily recorded in traditional ways (Storey, 2002)
- ICT enables teachers to engage and motivate pupils about geographical concepts to a greater degree (Halocha, 2002; Taylor, 2003)
- Using GIS software to produce and manipulate maps at a range of scales can save lesson time and give better quality results (Taylor, 2003)
- The internet increases access to authentic geographical data and information sources (Taylor, 2003)
- GIS software can enable teachers to focus more closely on teaching geographical skills, in addition to developing a sense of location and place (Keiper, 1999)

Factors for effective use

- Training for teachers on manipulating GIS helps them to integrate it effectively with their classroom practice (Audet and Paris, 1997; Johannson, 2003)
- Teachers make more effective use of GIS data and software when given guidance in locating suitable internet sources.
- Easier access to ICT resources enables geography departments to concentrate on development of geographical skills rather than ICT itself (Ofsted, 2004a)
- GIS activities can be more effective when coupled with the use of local data, in the context of authentic, real-life geographical issues (Keiper, 1999)

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).

Integrating ICT in geography learning – a secondary school case study

Staff at Sir John Nelthorpe School, Brigg, North Lincolnshire have developed an intranet as a whole-school resource for geography teaching and learning. The intranet's resources include virtual geography field trips, digital video and radio clips, multimedia presentations and web enquiries. Web enquiries are a selection of stimuli, prompts and questions or tasks which provide a structured activity using web-based resources as their raw material. A new development for the school is the creation of resources using Geographical Information Systems (GIS) and virtual terrain mapping.

The materials have been made available to pupils by adding them to the school website, as well as the intranet, so that pupils can access the information from local libraries or from home. Writing frames are on the website for pupils to copy and paste into a word processor, helping reduce the time required for structuring their work. Being able to access current information about geographical issues and redrafting work has helped to improve the quality of their work. Pupils are actively encouraged

to develop resources for publication on the site. The use of email has had an impact on the way teachers set homework and has changed the way they work with pupils.

The department has developed the use of video conferencing in the school, which took place in conjunction with their German partner school. The move to broadband is enabling the school to develop the use of web-based video conferencing. The geography department's use of the intranet has spread to other departments within the school – and to other schools across the UK. The website has won a number of awards and the head of department, Peter Humphries, was a runner-up in the 2004 Becta ICT in Practice Awards in the secondary teaching category. The Sir John Nelthorpe School geography resources can be found at <http://atschool.eduweb.co.uk/nelthorp/room8/intra/geograph/intro.htm>.

Information about the ICT in Practice Awards can be found at <http://www.becta.org.uk/awards>

Explanation of findings

The use of ICT across the geography curriculum is varied and, as with ICT more generally, its impact depends on the context and the ways in which it is used. Although it is often difficult to draw clear conclusions, some of the areas where ICT has been found to have positive effects are described below.

Geographical enquiry and skills

Pupils' understanding of specific geographical topics such as erosion and agriculture can be enhanced by using simulations and other multimedia resources. There is evidence to show that the use of these resources can enhance pupils' reasoning, decision-making and enquiry skills. During lessons involving multimedia resources, compared to traditional lessons, ICT has changed the roles of teacher and learner, with increased interactions between teacher and student and between pupils. (Cox and Abbott, 2003; Cox and Webb, 2003)

Geography in primary schools

Teacher-researchers on the Teacher Training Agency (TTA) Best Practice Research Scholarship initiative reported greater levels of primary pupils' understanding of time zones and climates. Although teachers had previously taught these topics using traditional resources, they found that live information received through email, webcams and video conferencing helped pupils understand concepts more easily. ICT enabled pupils to work with live information through video conferencing, and very quick response times through the use of emails increased students' motivation (Halocha, 2002).

When using ICT, teachers also reported a greater understanding of geographical patterns and processes. Pupils receiving ongoing reports about storms hitting the southern coast of Australia appeared to be able to discuss these in more detailed ways than when the teachers had used traditional resources. (Halocha, 2002)

The use of digital photography allows pupils to reflect on their work in the field after returning to the classroom. Photographs can be shared with pupils in other localities to allow comparison of place. Digital photography has an advantage over conventional photography because it is cheaper, quicker and more flexible, allowing it to be an everyday aspect of teaching and learning. (Storey, 2002)

Pupils' thinking about cause and effect also appeared to be enhanced when working with examples sent electronically by pupils from

other schools, such as Australian pupils providing their own evidence of their families' concerns about ozone depletion and what they did in order to minimise the risks of exposure to the sun. (Halocha, 2002)

Geography in secondary schools and the use of GIS

Ofsted's report on ICT in secondary geography found there were inconsistencies in the quality and use of ICT across schools. In too many cases, the limited time spent in ICT suites is used well to reinforce ICT skills, but there is too little focus on enhancing the delivery of geography. Lack of access at required times is often discouraging geography departments from using ICT. (Ofsted, 2004a)

However, Ofsted has found that some of the best work in secondary geography is with Geographical Information Systems (GIS). The benefits of using GIS include enabling pupils to explore patterns and relationships, to test hypotheses, to analyse large quantities of data and to recognise that the interpretation of large quantities of data is complex and yields a range of possible answers. (Ofsted, 2004b)

GIS has the ability to store, retrieve, manipulate and analyse a wide range of spatially-related data in order to produce maps. With GIS the user may ask questions of the data related to the map, search for patterns and distributions and investigate the underlying relationships between different sets of data. A computer-based GIS handles data quickly and efficiently, providing mapping facilities that would take a person many hours or even days to complete by hand.

Although there are signs that GIS technology is beginning to be found in the field of geography at all educational levels, there is still some way to go before it is an accepted and integral part of teachers' pedagogy (Kerski, 2001; West, 1999). A survey of secondary geography teachers in Finland (Johansson, 2003) revealed that teachers' knowledge of GIS and its use in the classroom was not extensive. Curriculum areas that would benefit from embedding GIS include initial teacher education and secondary school geography teaching (Henrickson, 2001). However, it is also argued that the educational benefits of using GIS in secondary education have yet to be proved (Lemberg and Stoltman, 1999).

About the research literature

The majority of the available research literature on the use of ICT in geography relates to secondary schools; there is very little evidence emerging from the primary sector (Cox and Abbott, 2003). Of the studies identified for this report, around half of them are concerned with Geographical Information Systems (GIS), though within these studies there is in fact little substantial evidence on the benefits of using this technology. Six of the 14 references cited here are from the UK, six are from the US, and one each from Finland and New Zealand. Other references were identified but later discounted as they proved to be studies of specific technologies which could be applied to the whole of the curriculum, rather than focusing on geography.

Key areas for further research

- How far are pupils able to use ICT effectively to develop their skills of geographical enquiry and critical thinking?
- Do pupils develop deeper conceptual understanding of geographical information as a result of using GIS and electronic maps?
- How does the use of ICT develop pupils' critical global thinking and understanding?
- How can one measure the added value gained from using ICT to make the abstract aspects of geography more concrete?
- What role is there for virtual fieldwork in a subject which espouses real experiences?

Further advice and resources for using ICT in geography

Becta ICT Advice

Becta is working in partnership with the subject associations to provide support for the use of ICT in certain subjects. A growing number of publications are available, including a series which showcases a selection of quality web-based resources to support primary and secondary subject teachers. To view the range of advice available on using ICT in geography visit the Becta ICT Advice website at www.ictadvice.org.uk.

Primary National Strategy

A range of example material CD-Roms are currently being developed by the Primary National Strategy as part of their 'Embedding ICT in Primary Schools' strategy. These resources are intended to support primary teachers in using ICT to enhance their teaching and learning. The primary geography materials will include using robots, mapping packages, images from the internet, digital camera work from outside the classroom and use of interactive whiteboards. More information on the embedding ICT strategy and the Example Material CD-Roms can be found at http://www.standards.dfes.gov.uk/primary/features/embedding_ict/943641/.

Key Stage 3 National Strategy

As part of the Key Stage 3 'ICT across the curriculum' support, geography materials have been produced in collaboration with the Geographical Association to show how ICT can support teaching and learning in geography. The materials feature a series of lesson plans and resources to be used in the classroom. Printed copies are available from DfES Publications (Tel. 0845 6022260 or email dfes@prolog.uk.com quoting reference DFES 0194-2004). Alternatively, the materials can be downloaded from http://www.standards.dfes.gov.uk/keystage3/respub/fs_ge_ict.

Enhancing subject teaching using ICT (ESTUIC) in Geography

This online CPD programme is designed to help teachers enhance geography teaching using ICT. Although the materials are specifically aimed at geography teachers at Key Stage 3, the topics will also be of interest to practitioners at other key stages.

<http://www.mpowernet.anglia.ac.uk>

Key questions for schools

- What is the level of teachers' confidence in using ICT in geography and how can this confidence be maximised?
- Do teachers have appropriate access to ICT resources, including specialist devices such as data-logging equipment, to meet curriculum demands inside and outside the classroom?
- Have you considered developing effective ICT links with the wider world?
- Are your LEA link inspectors, governors, teachers and parents aware of the potential of ICT to enhance the teaching of geography?

Bibliography and further reading

The research referred to in this briefing represents a selection of ICT research related to using ICT in geography, and should not be regarded as a definitive list of the 'most important' research in this area.

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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, send an email to ictrn@becta.org.uk or write to Michael Harris, ICT Research Network, Becta, Millburn Hill Road, Science Park, Coventry CV4 7JJ.

This briefing and others in the 'What the Research Says' series can be found on the Becta Research web site at www.becta.org.uk/research.

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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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