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ImpaCT2

The Impact of Information and Communication Technologies on Pupil Learning and Attainment

Summary

ImpaCT2 is one of the most comprehensive investigations into the impact of information and communications technology (ICT) on educational attainment so far conducted in the UK. This summary reports on the key findings from Strand 1 of the ImpaCT2 study.

Key findings from this strand

The aim of Strand 1 of the ImpaCT2 study was to analyse the relationship between pupils' use of ICT and their performance in National Tests and GCSEs.

The key findings from this strand of the study are outlined below:

- In every case except one the study found evidence of a positive relationship between ICT use and educational attainment.
- In none of the comparisons made between the attainment of groups of pupils with different levels of ICT use was there a statistically significant advantage to groups with lower ICT use.
- However, in some subjects the effects were not statistically significant and they were not spread evenly across all subjects.

Key Stage 2

- A statistically significant positive association between ICT and higher achievement in National Tests for English was found at Key Stage 2.
- Positive associations were also found for mathematics at Key Stage 2, although they were not as striking and not statistically significant.
- It is possible on the basis of these findings to estimate that high ICT use at Key Stage 2 in English can help to raise performance by 0.16 of a National Curriculum level, and in mathematics by 0.061 of a National Curriculum level. This is equivalent to a substantial acceleration in progress through these levels of 16% of two years' achievement in Key Stage 2 English, and 6.1% of two years' achievement in Key Stage 2 mathematics.

Key Stage 3

- A statistically significant positive association between ICT and National Tests for science was found at Key Stage 3, but there were no other clear-cut associations at Key Stage 3.
- It is possible on the basis of this finding to estimate that high ICT use at Key Stage 3 in science can help to raise performance by the equivalent of 0.214 of a National Curriculum level, and in mathematics by 0.083 of a National Curriculum level. This is equivalent to a substantial acceleration in progress through these levels of 21.4% of two years' achievement in Key Stage 3 science, and 8.3% of two years' achievement in Key Stage 3 mathematics.

Key Stage 4

- At Key Stage 4, there was a statistically significant positive association between ICT and GCSE science and in GCSE design and technology.
- It is possible on the basis of these findings to estimate that high ICT use at Key Stage 4 in science can help to raise performance by the equivalent of 0.56 of a GCSE grade, and in design and technology by the equivalent of 0.41 of a GCSE grade.
- There were also strong indications of a positive association in GCSE modern foreign languages (MFL) at Key Stage 4, and some indications of a positive association in GCSE geography, although neither reached statistical significance.
- It is possible on the basis of these findings to estimate that high ICT use in modern foreign languages can help to raise performance by the equivalent of 0.82 of a GCSE grade, and in geography by the equivalent of 0.37 of a GCSE grade.

However, it should be emphasised that:

- the proportion of lessons involving ICT was generally low over the period concerned. This is likely to rise as teachers gain in knowledge and experience, as equipment is made available in more classrooms and as there are improvements in the variety of software available, both on the Internet and on CD-ROM.
- there is no consistent relationship between the average amount of ICT use reported for any subject at a given key stage and its apparent effectiveness in raising standards. It therefore seems likely that the type of use is all-important.
- the schools involved in the ImpaCT2 study do not necessarily form a representative sample of schools in England.

Background to the ImpaCT2 Project

ImpaCT2 is one of a number of projects commissioned by the Department for Education and Skills (DfES) and managed by Becta with the aim of evaluating the progress of the ICT in Schools Programme. This Programme is the Government's key initiative to stimulate and support the use of ICT to improve standards and to encourage new ways of teaching and learning.

ImpaCT2 is a major study carried out between 1999 and 2002 involving 60 schools in England, and was designed to:

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- identify the impact of networked technologies on the school and out of school environment
- find out the degree to which these networked technologies affect the educational attainments of pupils at Key Stages 2, 3 and 4.

The study involved three related strands:

- **Strand 1:** to develop and apply appropriate methods for evaluating the use of ICT in school and out of school, and to analyse the statistical relationship between the effective implementation of ICT and standards of performance in National Tests and GCSEs.
- **Strand 2:** to develop and apply a variety of methods to establish *how* pupils use ICT, in particular out of school, and what is gained from such use.
- **Strand 3:** to explore the nature of teaching and learning involving ICT in various settings, with a focus on the views of pupils, teachers and parents.

The ImpaCT2 study was jointly carried out by a team of researchers from the University of Nottingham, the Open University, Manchester Metropolitan University and the University of Leicester, and led by Professor Colin Harrison at the University of Nottingham.

This summary reports on the key findings from strand 1 of the study.

The Approach taken in Strand 1

Impact of ICT

After having established the relative frequency and context of use in each subject, the study explored the relationship, if any, between the use of ICT and performance in National Tests and GCSEs. The achievement of 700 pupils at each of Key Stages 2, 3 and 4 was predicted using 'baseline' data, and then compared with their actual results.[1] The baseline data was calculated from tests that the pupils had undergone approximately eighteen months earlier (during 1999-2000). This comparison produced a relative gain score for each pupil, which is zero if the pupil did as predicted, positive if the pupil did better than expected, and negative if worse than expected.

Pupils were allocated to one of two groups, 'High ICT' or 'Low ICT' according to whether the extent of their ICT use in a particular subject fell above or below a cut-off point based on the median (middle) score for that subject at that key stage.

It was then possible to compare the *mean (average) relative gain* scores for each group of pupils. The graphs on the following two pages provide a comparison of the mean relative gain scores achieved by the high ICT group and the low ICT group for each subject at each key stage.

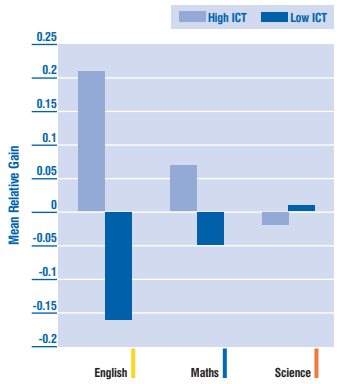
The mean relative gain scores across the three key stages included in this study have also been standardised, for the purposes of easier analysis of the varying impact of ICT use across the key stages.

Key Stage 2

Impact of ICT

Figure 1 shows how the relative gain scores of the group of pupils characterised as high ICT users compared with low ICT users in each of three subjects – English, mathematics and science – at Key Stage 2.

Figure 1: Mean relative gain at Key Stage 2 for high ICT users versus low ICT users (ICT use data drawn from a total of 700 questionnaires administered during 2001)



As Figure 1 illustrates, pupils characterised as high ICT users outperformed, on average, low ICT users in English and mathematics (the height of the bars for each subject for each group shows the extent of the gain). The numbers on the scale on the left of the graph relate to the average advantage gained by each group, that is, the average difference between what the pupils were expected to achieve and what they actually did achieve in National Tests at Key Stage 2.

These differences are expressed in 'standard deviations', a statistical term for the average difference from the mean (average) for a group of results. A relative gain score of 1 would signify that the average result achieved by the pupils involved in the ImpaCT2 study in a particular subject and Key Stage was one standard deviation higher than their expected average result.

In Figure 1 the most powerful impact of ICT use can be seen to be in English – a figure of 0.2. This actually represents a statistically significant (and positive) impact for high ICT use in English. Statistical significance is a way of measuring how certain we can be regarding a particular finding. In this case, we can be fairly certain regarding the finding of a positive impact of high ICT use in English.

In mathematics, there is a positive association but it is not statistically significant.

It may be thought that the lack of statistical significance implies that pupils' use of ICT in mathematics and science has no effect on their performance in those subjects. However, not reaching statistical significance does not mean that a result is unimportant or uninteresting.

It may be that considerations of differences in practice (that is, how ICT is applied in addition to how often) are needed to more fully understand these findings. The report on which this summary is based begins to explore these differences at an individual school level.

It is also possible to provide a further interpretation of the relative gain scores by translating them into National Curriculum levels for each subject. National Curriculum levels measure children's progress in each subject. Broadly, one level is thought to relate to around two years in a pupil's development. Note, however, that these gains can only represent approximations, because the number of marks separating levels varies from level to level, and because the clustering of marks can vary from subject to subject.

[1] More information regarding Key Stages, National Curriculum levels and National Tests can be found in the DfES publication series *Learning Journey*, the National Curriculum on-line web site (www.nc.uk.net) and on the DfES Parents' web site (www.dfes.gov.uk/parents).

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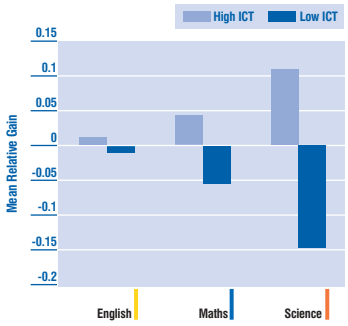
- High ICT use in Key Stage 2 English in particular can be seen to support a substantial acceleration in progress through these levels equivalent to 16% of two years' achievement.
- In Key Stage 2 mathematics the acceleration in progress is equivalent to 6.1% of two years' achievement.

Key Stage 3

Impact of ICT

Figure 2 shows how the relative gain scores of the group of Key Stage 3 pupils characterised as high ICT users compare with low ICT users in each of three subjects – English, mathematics and science – at Key Stage 3. The effects are less striking than at Key Stage 2.

Figure 2: Relative gain at Key Stage 3 for high ICT users versus low ICT users (ICT use data drawn from a total of 700 questionnaires administered during 2001)



As Figure 2 illustrates, in all three subjects the pupils characterised as high ICT users outperformed, on average, low ICT users. As with the graph for Key Stage 2, the numbers on the scale on the left of the graph relate to the average advantage gained by each group, that is, the average difference between what the pupils were expected to achieve and what they actually did achieve in National Tests at Key Stage 3. Again, these differences are expressed in 'standard deviations'. In Figure 2 the most powerful impact of ICT use can be seen to be in science. This actually represents a statistically significant (and positive) impact for high ICT use in science.

In mathematics and English, there is a positive association but it is not statistically significant. It should be noted that not reaching statistical significance does not mean that a result is unimportant or uninteresting. The positive nature of the effects gives further credence to the view that the observed impacts of ICT are not random fluctuations in the data.

As at Key Stage 2, it may be that considerations of differences in practice (that is how ICT is applied in addition to how often) are needed to more fully understand these findings. The report on which this summary is based begins to explore these differences at an individual school level.

As with Key Stage 2, it is also possible to provide a further interpretation of the relative gain scores by translating them into National Curriculum levels for each subject. Note, however, that these can only represent approximations, because the number of marks separating levels varies from level to level, and because the clustering of marks can vary from subject to subject.

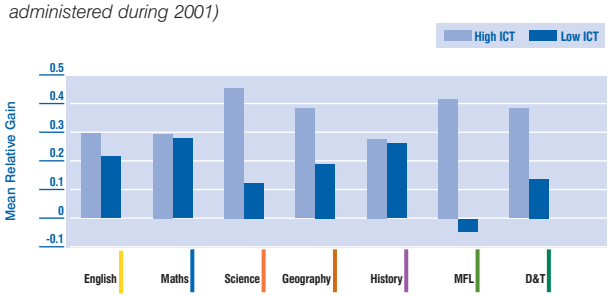
- High ICT use in Key Stage 3 science in particular can be seen to support a substantial acceleration in progress through these levels equivalent to 21.4% of two years' achievement.
- In Key Stage 3 mathematics the acceleration in progress is equivalent to 8.3% of two years' achievement.

Key Stage 4

Impact of ICT

Figure 3 shows how the relative gain scores of the group of Key Stage 4 pupils characterised as high ICT users compare with low ICT users in each of the GCSE subjects investigated. The effects are less striking than at Key Stage 2 and more striking than at Key Stage 3.

Figure 3: Relative gain at Key Stage 4 (GCSE) for high ICT users versus low ICT users (ICT use data drawn from a total of 700 questionnaires administered during 2001)



As Figure 3 illustrates, in all of the subjects investigated the pupils characterised as high ICT users outperformed, on average, low ICT users.

As with the equivalent graphs for Key Stage 2 and Key Stage 3, the numbers on the scale on the left of the graph relate to the average advantage gained by each group, that is, the average difference between how the pupils were expected to achieve and what they actually did achieve in National Tests (GCSEs) at Key Stage 4. Again, these differences are expressed in 'standard deviations'.

In Figure 3 the differences are slight and not statistically significant for English, mathematics and history. The differences in performance are much more considerable for science and for geography (though the latter just failed to reach statistical significance, the number of pupils involved being less for non-core subjects than it is for core subjects).

The greatest difference in mean performance between high ICT and low ICT pupils is found in modern foreign languages, despite the fact that overall usage in this subject was quite low.

In the case of design and technology, the subject with the highest reported use of ICT, differences in favour of higher ICT levels were found to be statistically significant in all analyses.

Again, it may be thought that the lack of statistical significance implies that pupils' use of ICT in mathematics and English has no effect on their performance in those subjects. However, the non-statistically significant effects are all positive giving some credence to the view that the positive effects observed are not random fluctuations in the data.

That the most significant associations were found in science at Key Stage 4 may well be a reflection of the fact that science teachers in general have been developing materials and procedures longer than in other curriculum areas and have found ways of capitalising on the potential of the medium. Again, in science, there is a clear alignment

between the content of the ICT and the content of the examination. The same is true of design and technology and of modern foreign languages. In some other subjects, and especially in English at secondary level, there is no such correspondence between the content of the ICT used and the content of the examination. The skills that pupils are learning in becoming more expert at presenting their work effectively on the computer are not tested in Key Stage 3 National Tests, or at GCSE.

Evidence from lesson observations pointed to a variety of approaches to integrating ICT within subject teaching. The report on which this summary is based begins to explore the differences in practice at an individual school level in a way that may illuminate the findings.

It is also possible to provide a further interpretation of the relative gain scores by translating them into GCSE grades for each subject. These provide estimates of the actual advantage in terms of grades associated with the performance of high and low ICT groups after taking into account differences in their initial achievement levels at Key Stage 4.

- At Key Stage 4 in English, the difference in test performance between high and low ICT groups was equivalent to a score of 0.13 of a GCSE grade.
- At Key Stage 4 in mathematics, the difference in test performance between high and low ICT groups was equivalent to a score of 0.02 of a GCSE grade.
- At Key Stage 4 in science, the difference in test performance between high and low ICT groups was equivalent to a score of 0.56 of a GCSE grade.
- At Key Stage 4 in geography, the difference in test performance between high and low ICT groups was equivalent to a score of 0.37 of a GCSE grade.
- At Key Stage 4 in history, the difference in test performance between high and low ICT groups was equivalent to a score of 0.03 of a GCSE grade.
- At Key Stage 4 in modern foreign languages, the difference in test performance between high and low ICT groups was equivalent to a score of 0.82 of a GCSE grade.
- At Key Stage 4 in design and technology, the difference in test performance between high and low ICT groups was equivalent to a score of 0.41 of a GCSE grade.

As noted before, in all subjects investigated the pupils characterised as high ICT users outperformed, on average, the low ICT users.

While the use of relative gain scores seeks to create a 'level playing field' by comparing pupils' achieved results with their predicted results (rather than by comparing pupil with pupil) it remains the case that some pupils will make more progress than others. Some of this may be due to ICT or other educational effects.

Conclusion

The principal outcome of this survey is clear and by no means entirely expected: ICT has been shown to be positively associated with improvement in subject-based learning in several areas. That contribution was statistically significant though not large. In none of the comparisons made between pupils' expected and actual scores in National Tests or GCSEs was there a statistically significant advantage to groups with lower ICT use. This is in contrast to the findings of many earlier studies.

It was clear, from visits to schools and from the various methods used to find out the attitudes of pupils, that ICT was generally popular. That finding was perhaps to be expected. What was not anticipated was that for the most part pupils were familiar with handling computers and were not intimidated by the demands of the applications used. No doubt this is in part due to the increasing numbers of computers in homes, and in part to the effectiveness of the ICT curriculum itself in Key Stages 1 and 2 (Years 1 to 5 in particular).

There is evidence that, taken as a whole, ICT can exert a positive influence on learning, though the amount may vary from subject to subject as well as between key stages, no doubt reflecting factors such as the expertise of teaching staff, problems of accessing the best material for each subject at the required level, and the quality of ICT materials that are available.

It should be emphasised that the proportion of lessons using ICT in the schools involved in the ImpaCT2 study was generally low over the period concerned. This is likely to rise as teachers gain in knowledge and experience, as equipment is made available in more classrooms and as there are improvements in variety of software available, both on the Internet and on CD-ROM.

The observations made as part of this study took place during the early-mid period of the ICT in Schools Programme during which the nature of ICT in schools, in terms of both provision and practice, has been developing. Schools have come a long way in recent years but are still at different stages of integrating ICT with everyday practice.

The intervening period has also witnessed significant advances in the range of technologies and applications available to the education and home markets and in the growth of access to ICT outside school. There is every sign that these trends are set to continue. This progress reflects tremendous vision, initiative and commitment at all levels of the education sector and has been achieved within the context of the programme.

However, while progress towards these goals has been significant and can rightly be celebrated, it is only the beginning of an ongoing transformation that over time will deliver exciting new opportunities for individuals to personalise their learning and realise their potential in school, at home and in the community. These opportunities will become a reality as ICT becomes firmly embedded in all aspects of school life rather than as an 'optional extra'.[2]

Further information

The fuller report, on which this summary is based, as well as the earlier ImpaCT2 Interim Findings[3] and the Preliminary Reports[4], is available on the Becta Research web site at:

www.becta.org.uk/research/impact2.

The fuller report examines the findings in more depth, including discussing the possible reasons why the effects were not spread evenly across all subjects.

Further publications in this series will set out the findings from other strands of the study. A full report of the ImpaCT2 findings (including a more detailed description of the research methods employed), is forthcoming, and will also be published on the Becta Research web site.

Other reports in the ICT in Schools Research and Evaluation series are also available on the Becta Research web site.

[2] A vision for the future of ICT in schools is provided in the paper *Transforming the Way We Learn* (DfES, 2002), available at: www.dfes.gov.uk/ictfutures.

[3] Becta (2001), *ImpaCT2 – Emerging Findings from the Evaluation of the Impact of Information and Communications Technologies on Pupil Attainment* (Becta, Coventry: www.becta.org.uk/research/reports/impact2).

[4] McFarlane et al. (2000), *ImpaCT2 Project Preliminary Study 1 – Establishing the Relationship between Networked Technology and Attainment* (Becta, Coventry: www.becta.org.uk/research/reports/impact2); Lewin et al. (2000), *ImpaCT2 Project Preliminary Study 2 – Promoting Achievement: Pupils, Teachers and Contexts* (Becta, Coventry: www.becta.org.uk/research/reports/impact2).

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