E-maturity and School Performance - A Secondary Analysis of COL Evaluation Data
Analysis Report

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EXECUTIVE SUMMARY

The British Educational Computing and Technology Agency (BECTA) commissioned the National Centre for Social Research to conduct a secondary analysis of school- and teacher-level data obtained from the evaluation of the Curriculum Online programme. The aims of the secondary analysis were to investigate changes in the use of and attitudes towards ICT in schools over time and so map stages of "E-maturity", and to explore the relationship between these indicators of ICT and school performance. "E-maturity" indicates the extent to which schools and their teachers make the use of ICT integral to their teaching and planning of teaching activities and provide students access to ICT inside and outside the classroom. The index was composed of three so-called dimensions, measuring ICT infrastructure and resources, organisational co-ordination of ICT resources, and "engagement with learners", that is, the extent to classroom and out-of-lesson use of ICT resources in a school.

For each school an E-maturity score was calculated based on these dimensions, which were summed to form the E-maturity score. Change in these scores between 2002 and 2005 were studied and associations with school performance indicators analysed.

E-maturity Levels and Changes between 2002 and 2005

Levels of E-maturity were found to have increased significantly between 2002 and 2005 in primary and secondary schools. At current point levels of 24.8 and 24.9 respectively, primary schools and secondary schools have, on average, reached approximately 70 percent of the total maximum score on the E-maturity scale.

The largest changes in E-maturity scores were recorded for primary schools, which, on average, had lagged behind secondary schools in terms of E-maturity in 2002, but by 2005 had achieved almost identical levels of E-maturity to those of secondary schools.

Improvements in aggregate E-maturity benefited from higher initial scores on the resource dimension (primary and secondary schools) and higher scores on the learning engagement dimension (secondary schools only). Primary schools particularly increased their scores on the organisational co-ordination dimension, whereas secondary schools, on average, improved their E-maturity similarly across all three dimensions. Although primary schools' overall E-maturity scores was similar to that of secondary schools, they continued to lag behind in terms of their ICT infrastructure and resources. However, they led secondary schools in terms of their organisational co-ordination of ICT resources.

Between 2002 and 2005, E-maturity scores increased more in primary and secondary schools where E-maturity scores were already higher in 2002. In addition, E-maturity increased in primary schools with the size of the school. Primary schools with higher proportions of students with special educational needs were also more likely to increase their E-maturity scores between 2002 and 2005, as were secondary schools that had specialised in science and technology subjects. Other indicators of E-maturity improvements were primary schools' non-participation in the Excellence in Cities programme and secondary schools' status as Christian (rather than non-denominational) schools.

E-maturity and School Performance

There was no evidence of a positive association between performance measures and increased E-maturity in primary schools. E-maturity increases in primary schools between 2002 and 2005 were associated with a lower proportion of authorised absences during the first year of the observation period, but not with absences in the final year. As a result, total change in authorised absences over this period was also not statistically associated with E-maturity improvements.

For secondary schools, statistically significant associations existed between increased E-maturity and lower absence rates in 2005, and improvements, between 2002 and 2005, in KS3 average points and in the percentage of A* - C grades at KS4. These findings suggest an association between E-maturity and performance, but they may not be taken as evidence of a causal link.

1 INTRODUCTION

1.1 Aims of the Study

The British Educational Communications and Technology Agency (BECTA) commissioned NatCen to carry out secondary analysis of data from the evaluation of Curriculum Online (COL). COL is an online service funded by the Department for Education and Skills (DfES) and managed by BECTA to enable teachers and schools to obtain information about and to procure multimedia resources for use in lessons.

There were two main aims to the secondary analysis. First, to investigate changes in the use of and attitudes towards ICT in schools over time and so map stages of "E-maturity". By "E-maturity", we mean the extent to which schools and their teachers make the use of ICT integral to their teaching and planning of teaching activities and provide students access to ICT inside and outside the classroom.

The second aim was to investigate the relationship between these indicators of ICT and school performance.

Specifically, the objectives of the study were to:

- Construct a measure of schools' level of "E-maturity" based on COL data.
- Map changes in this measure of E-maturity over the course of the COL study (2002-2005) and compare the characteristics of schools that have improved their relative position on E-maturity with other schools in order to build up a picture of the path to E-maturity.
- Explore the association between E-maturity and a range of school performance data over the period 2002-2005.

BECTA aims to "increase the number of educational organisations making strategic and effective use of ICT in order to improve educational outcomes" (BECTA Self-Review Framework 2006) by creating models of E-maturity and providing a framework against which schools can benchmark themselves, draw up action plans and review their progress. The longitudinal nature of the COL survey and the fact that the same schools were interviewed in 2002, 2003 and 2005 provided a unique opportunity to explore changes in schools' situation over this period and to study schools' progression towards greater E-maturity.

Recent studies have produced contradictory evidence of the effect of ICT on learning (e.g. EPPI, 2003; OECD, 2006) and there remains as yet little robust evidence to suggest a direct link between ICT and schools' performance. The second research stage of this project was designed to contribute to the current evidence base using a nationally representative sample of primary and secondary schools in England.

The report presents the results of our analysis and some interpretation of the findings. Throughout the report, we will refer to the association between E-maturity and attainment because the data typically does not allow us to be certain about the direction of effects. We can, therefore, not say whether changes in, say, attainment followed changes in E-maturity, or vice versa. By referring to associations (or, sometimes, relationships) between data, we want to stress that it is not (yet) possible to suggest or assume any (direction of) causality between variables.

We begin our report by providing details on the data used and explaining of how we decided on the measure of E-maturity to be used.

1.2 The Data

The report combines a measure of schools' E-maturity based on survey data with data on schools' background characteristics and performance collected by DfES.

COL Survey Data

E-maturity was measured using data obtained from the Curriculum Online survey of schools 2002, 2003 and 2005, based on a series of survey responses and attitude statements concerned with the availability and use of ICT in schools. E-maturity scores, about which we will say more in section 1.3 below, were calculated for each of the three survey years based on all the schools that provided data on the different indicators of E-maturity for that year. Sample sizes for the three years are given in Tables 1.1 and 1.2. Subsequent analysis looking at the process of change in E-maturity used a panel of 143 primary and 135 secondary schools present in the first (2002) and third (2005) COL surveys. When examining the link between changes in E-maturity and school performance the size of the panel was reduced to the 121 primary and 131 secondary schools for which attainment data was available. A second panel comprising 120 primary schools and 119 secondary schools present in the first (2002) and second (2003) surveys, and for which attainment data was available for every year between 2002 and 2005, was also used to examine the link between E-maturity and school performance. This allows us to test whether there was a lagged effect of E-maturity on school attainment using performance data from after 2003. A summary of the survey data used for each stage of the analysis is shown in Table 1.3.

Table 1.1 Final Sample Sizes: Primary Schools

	Total Sample	E-maturity Scores Available	Attainment Data Available
2002	359	271	N/A
2003	261	197	N/A
2005	236	182	N/A
2002 + 2003 panel	261	143	120
2002 + 2005 panel	236	143	121

Note: N/A = not applicable

Table 1.2 Final Sample Sizes: Secondary Schools

	Total Sample	E-maturity Scores Available	Attainment Data Available
2002	331	260	N/A
2003	247	185	N/A
2005	195	154	N/A
2002 + 2003 panel	247	162	119
2002 + 2005 panel	195	135	131

Note: N/A = not applicable

Table 1.3 Summary of Survey Data used in Analysis

Analysis	COL Data Used
E-maturity scores	2002, 2003, 2005
Process of Changing E-maturity	2002 + 2005 panel
E-maturity and attainment	2002 + 2005 panel, 2002 + 2003 panel

School Characteristics Data

Data on the demographic and administrative characteristics of the schools in the sample were taken from Edubase, the DfES' database of all educational establishments across England and Wales. The data describe schools' circumstances as they were in March 2006, when the data were obtained. It may well be that circumstances were different at the time of the COL surveys, although major changes are unlikely. A list of the school characteristics used in the analysis is given below (Table 1.4). Other contextual variables were available (e.g. gender of pupils, school admissions policy) but were excluded from the analysis because there was not sufficient variation across schools in the sample. Some of the variables have been regrouped into a smaller number of categories than were available in the original Edubase data to ensure that there are sufficient numbers of cases available for analysis.

Table 1.4 School Characteristics used in Analysis

Main Characteristic	Categories of Main Characteristics
Number of pupils on school roll	
% pupils receiving free school meals	
% minority ethnic pupils	
% pupils with special educational needs (SEN)	
Type of school	Community/voluntary controlled, foundation/voluntary aided
Religion	Christian, none
Region	South, Midlands, North
Specialism (secondary schools only)	None, science/technology, other specialism
Excellence in Cities participant	

Pupil Attainment Statistics

School-level attainment data were obtained from the DfES' School and College Achievement and Attainment Tables. The attainment data used relates to performance in the school years 2001-02, 2002-03, 2003-04 and 2004-05. Unfortunately data for 2005-2006, i.e. the school year in which the last COL survey was conducted are not yet available. A number of different measures of school performance were used.

For primary schools, attainment was measured in terms of:

- Average points score at Key Stage 2 (KS2) (i.e. average score obtained by pupils across Maths, English and Science KS2 tests);
- Aggregate percentage of pupils achieving Level 4+ in KS2 tests (sum of % pupils across Maths, Science and English);
- Value added KS1 to KS2 (base=100); and
- Percentage of ½ day authorised absences.

For secondary schools, attainment was measured in terms of:

- Average points score at Key Stage 3 (KS3) (i.e. average score obtained by pupils across Maths, English and Science KS3 tests);
- Aggregate percentage of pupils achieving Level 5+ in KS3 tests (sum of % pupils across Maths, Science and English);
- Value added KS2 to KS3 (base=100);
- Percentage of pupils achieving Level 1 at Key Stage 4 (KS4) (i.e. 5 or more A*-G grade GCSEs or equivalent);
- Percentage of pupils achieving Level 2 at Key Stage 4 (KS4) (i.e. 5 or more A*-C grade GCSEs or equivalent);
- Value added KS3 to KS4 (base=1000); and
- Percentage of ½ day authorised absences.

Unlike KS2 and KS3, it was not possible to use average points scores at KS4 because the way this measure is calculated changed between 2002 and 2005, that is, during the period of the COL evaluation.

Value-added scores measure the progress that individual pupils have made between tests at the end of one Key Stage and tests at the end of the next Key Stage. By controlling for pupils' prior achievements and abilities they provide a more accurate reflection of schools' effectiveness than raw performance scores. The value-added scores are centred on 100, which represents the national average. Scores above the base figure indicate pupils at these schools, on average, made greater progress in terms of attainment than was typically the case across England. Measures below the base figure indicate that progress in attainment between Key Stages was below the national average.

The school performance indicator "percentage of ½ day authorised absences" was included as a measure that might capture pupil motivation, which, along with attainment, may be influenced by the use of ICT in schools.

Table 1.5 Summary of Available Data by School Year

	2001-02	2002-03	2003-04	2004-05	2005-06
COL surveys		Wave 1 Baseline Nov 02	Wave 2 1st follow up Nov 03		Wave 3 2nd follow up Nov 05
School characteristics data					2006
Attainment data	X	X	X	X	

1.3 A Measure of E-maturity

E-maturity was measured using a range of indicators taken from the COL Evaluation questionnaire. The choice of indicators was designed to cover a wide range of different aspects of E-maturity. They include both, measures of attitudes and "hard" data on the availability and use of resources. The selection of indicators was informed by a workshop, organised by BECTA. Participants in the workshop had experience of ICT in schools and were asked to suggest items from the COL survey questionnaires that could serve as indicators of the key aspects and objectives of E-maturity: infrastructure, resources, organisational co-ordination, workforce, 'engaging the learner', and 'extending opportunities'.

A final choice of indicators was made from this initial selection. In making the final choice of indicators the following were taken into consideration. All indicators had to be available for both primary and secondary schools and across all three years of the survey to allow comparisons to be made. Each indicator should appear on only one of the dimensions of E-maturity to ensure that each dimension remained distinct. Indicators were chosen from both the school-level and teacher-level COL questionnaires. However, where the same question was asked in both the school and teacher questionnaires, the school-level indicator was given preference, as there were fewer problems with missing data. Indicators that were highly correlated with other indicators were excluded, as were indicators on which there was little or no variation across schools (e.g. questions asking about the presence of broadband, or attitudes towards the benefits of ICT). All questions were 'closed', that is, offered response options to participants, which the latter were asked to select (by ticking boxes).

The chosen indicators were re-grouped from the original six into three dimensions, taking account of the overlap and similarities: (1) infrastructure and resources, (2) organisational co-ordination and workforce, and (3) engaging the learner, with four indicators on each dimension. A summary of the indicators used on the different dimensions is given below (Table 1.6). Full details on question wording and how scores were assigned for each indicator can be found in Appendix A. Each indicator was given a score from 1 to 3, 3 being the most “E-mature” response. The workshop and subsequent enquiries determined the sequence of least to most E-mature responses, where this was not already apparent from the questions' response options. Scoring questions between1 and 3 ensured that each question was given the same weight in the construction of the E-maturity index. In some instances, this required re-coding response options, typically by merging graded responses. For instance, 'strongly agree' and 'agree' would be re-coded into a single variable indicating agreement, as would be the disagreement statement 'strongly disagree' and 'disagree', leaving 'neither agree nor disagree.

Since each of the three dimensions incorporated four indicators, schools were given a score from 1 to 12 on each dimension. Summing over the three dimensions, schools received an overall E-maturity score of between 1 and 36, with higher scores representing greater E-maturity.

Table 1.6 Indicators of E-maturity

Infrastructure and Resources	Organisational Co-ordination and Workforce	Engaging the Learner
School ‘s pupil/computer ratio and pupil/interactive whiteboard ratio	Availability of subject- dedicated computers and interactive whiteboards for use in lessons	Rating of fitness for purpose of computers and interactive whiteboards
Rating of speed of school Internet connection	School’s rating of how important a role ICT plays in teaching for different subjects	Frequency with which computer packages, Internet resources , and subject specific software are used in lessons
Proportion of computers linked to a network	Confidence of teachers in using ICT to deliver curriculum	Teacher rating of importance of ICT in teaching
How well current funding meets school’s technical support and training needs	Proportion of lesson planning done using digital resources	Pupil access to ICT resources outside of lessons

PART I

2 E-MATURITY IN SCHOOLS

Part 1 of the report provides an overview of the level of E-maturity in schools in 2005 and of the changes in E-maturity that took place in the three years leading up to 2005. It compares E-maturity scores at wave 3 of the COL survey (2005) with scores at wave 1 (2002) and wave 2 (2003). Overall E-maturity scores are considered alongside scores on the three core dimensions of E-maturity: infrastructure and resources, organisational co-ordination and workforce, and engaging the learner. Using a panel of schools that participated in wave 1 as well as wave 3 of the COL evaluation, we compare patterns of change in E-maturity between and within schools from 2002 to 2005, and explore the association between school characteristics and E-maturity. Separate analyses are presented for primary and secondary schools.

2.1 The Level of E-maturity in Schools

In 2005, the average E-maturity score in primary schools was 24.8 points compared to 24.9 points in secondary schools, rising from 20.4 and 22.3 points respectively in 2002 (Tables 2.1 and 2.2). Although the nominal increases in the mean score to 2005 were for both types of schools fairly modest (4.4 points for primary schools; 2. 7 points for secondary schools), they represent a statistically significant improvement on E-maturity in 2002 (and also 2003). As these figures indicate, whereas in 2002, primary schools' average E-maturity lagged visibly behind that of secondary schools (20.4 versus 22.3 points), by 2005, primary schools had caught up with secondary schools and E-maturity scores were about the same for both types of schools.

In 2005, primary schools achieved, on average, similar scores on all three dimensions of E-maturity. There was slightly more variation in the performance of secondary schools which, on average, scored highest on the infrastructure dimension (8.9) and lowest on the organisational co-ordination dimension (7.7). Secondary schools outperformed primary schools on the infrastructure dimension, whereas primary schools outperformed secondary schools on organisational co-ordination. However, whilst the difference in scores between primary and secondary schools was statistically significant, absolute difference in scores were, in fact, small (0.5 points).

Table 2.1 Summary of E-maturity Scores in Primary Schools

		2002	2003	2005	Change 2002-05
E-maturity					
	Mean	20.4	22.1	24.8	4.4 *
	S.D	2.5	2.7	2.9	
	Min	13.3	16.6	15.6	
	Max	27.7	30.2	31.6	
Infrastructure					
	Mean	7.2	7.9	8.4	1.2 *
	S.D	1.3	1.4	1.4	
	Min	4.0	4.5	5.0	
	Max	11.0	11.0	11.5	
Organisation/Co-ordination					
	Mean	6.4	7.1	8.2	1.8 *
	S.D	1.1	1.1	1.4	
	Min	4.2	4.3	4.5	
	Max	9.8	10.7	11.8	
Engaging the learner					
	Mean	6.7	7.2	8.1	1.4 *
	S.D.	1.1	1.0	1.1	
	Min	4.4	5.2	4.7	
	Max	10.2	10.2	10.8	
Base N		271	202	182	

Note: * statistically significant difference 2002-2005 at 5% level

Table 2.2 Summary of E-maturity Scores in Secondary Schools

		2002	2003	2005	Change 2002-05
E-maturity					
	Mean	22.3	23.0	24.9	2.6 *
	S.D	2.4	2.7	2.5	
	Min	15.1	16.8	19.6	
	Max	30.4	30.5	30.7	
Infrastructure					
	Mean	8.4	8.7	8.9	0.5 *
	S.D	1.3	1.2	1.1	
	Min	4.0	5.5	5.5	
	Max	11.0	12.0	11.0	
Organisation Co-ordination					
	Mean	6.6	6.9	7.7	1.1 *
	S.D	1.1	1.2	1.1	
	Min	4.1	4.3	5.2	
	Max	10.1	9.8	10.7	
Engaging the learner					
	Mean	7.2	7.4	8.3	1.1 *
	S.D.	1.0	1.1	1.1	
	Min	5.0	4.7	5.8	
	Max	10.3	10.4	10.8	
Base N		265	172	154	

Note: * statistically significant difference 2002-2005 at 5% level

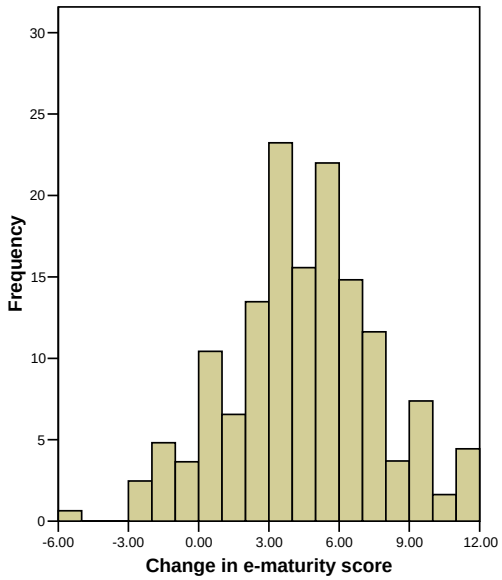
Despite the significant improvements in E-maturity in both primary and secondary schools between 2002 and 2005, there appears to be scope for further improvement since the average score on overall E-maturity was only around 70% of the maximum possible (36). The maximum score in primary schools was 31.6 out of a possible 36, whilst the minimum was 15.6. The corresponding figures for secondary schools were 30.7 and 19.6.

2.2 Changes in E-maturity 2002 - 2005

The average increase between 2002 and 2005 in overall E-maturity score in primary schools was 4.5 points. The average increase in E-maturity in secondary schools was smaller at 2.7 points, which, in part, reflected the stronger starting position of secondary schools in 2002. Primary schools significantly increased their scores on all three dimensions with the biggest average change (1.9 points) occurring on the organisational co-ordination dimension. Among secondary schools, there was a small, though still statistically significant change of 0.5 points in scores on the infrastructure dimension. Larger changes occurred on the other two dimensions, organisational co-ordination and engaging the learner, on which scores in 2002 had been lower. The average increase on these two dimensions was 1.1 points.

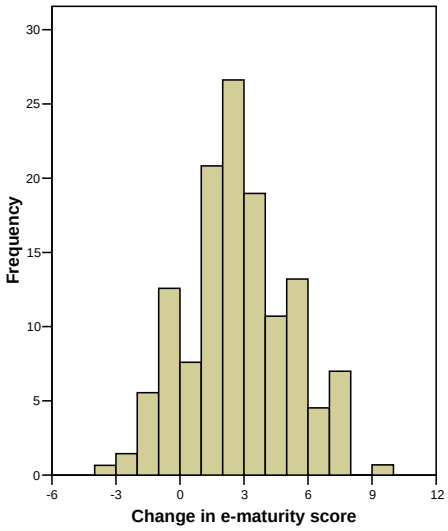
Figures 2.1 and 2.2 show the distribution of the change in schools' E-maturity scores between 2002 and 2005. A comparison reveals that more primary schools than secondary schools increased their scores by comparatively high values of 9 points or more. Whereas the majority of primary and secondary schools increased their E-maturity scores during the period[1], in eight percent of primary schools and 15 percent of secondary schools E-maturity scores declined over this period.

Figure 2.1 Change in Primary Schools' E-maturity Score 2002-2005



[1] Their change value was greater than 0, that is, to the right of the value on the horizontal scale.

Figure 2.2 Change in Secondary Schools' E-maturity Score 2002-2005



Figures 2.3 and 2.4 provide a further, yet more detailed illustration of changes in E-maturity scores between 2002 and 2005, plotting individual schools' scores in each year. The diagonal line drawn in both plots divides schools with improved scores (top half) and schools with reduced scores (bottom half) in 2005. The greater scattering of points on the graph for primary schools reflects the fact that primary schools saw greater increases in E-maturity scores between 2002 and 2003 than did secondary schools.

Figure 2.3 Scatterplot of 2002 and 2002 E-maturity Scores: Primary Schools

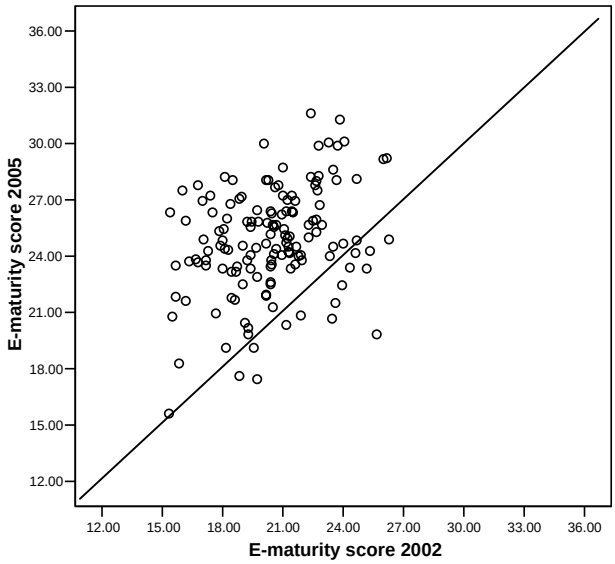
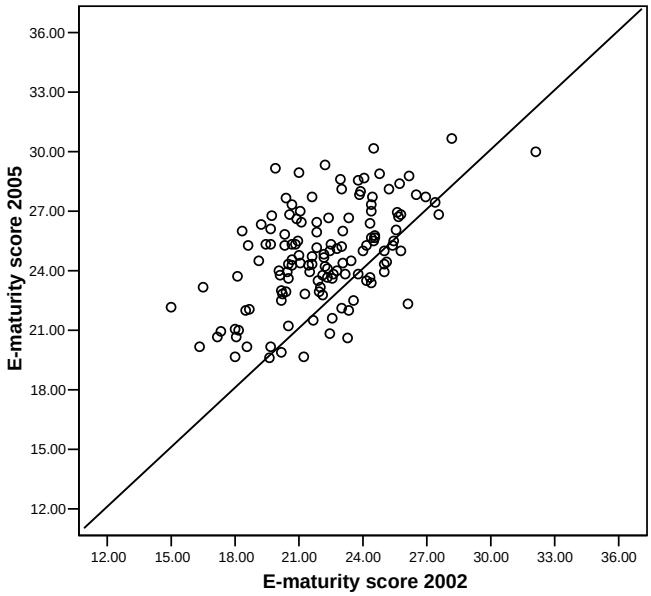


Figure 2.4 Scatterplot of 2002 and 2005 E-maturity Scores: Secondary Schools



2.3 The Path to E-maturity

To gain a better understanding of how schools progressed towards greater E-maturity, we compared changes over time in each of the three dimensions of the E-maturity index. The schools themselves were divided into three categories of 'high', 'medium' and 'low' achievers of E-maturity. This distinction was based on the size of the difference of a school's aggregate E-maturity score and the grand mean of the E-maturity score for all primary or secondary schools. Schools falling more than one half of a standard deviation below the grand mean were classed as 'low' achievers while those achieving more than one half of a standard deviation about the grand mean were classed as 'high' achievers. Those within one half of a standard deviation of the mean were labelled 'medium' performers. Drawing the line at one-half of a standard deviation ensured sufficient difference between the three groups of schools and their E-maturity scores to expect distinct school features and characteristics to affect the scores, while assigning to each group a sufficient number of cases that would be required for this analysis. In the subsequent comparisons, we examined (1) how the different dimensions of E-maturity combined to determine a school's overall performance and (2) how the final position that schools obtained on E-maturity by 2005 was influenced by their starting position in 2002.

Figure 2.5 and 2.6 show the results of the comparison of high, medium and low performing schools' E-maturity scores obtained on the three dimensions of E-maturity at wave 3 (2005). The comparison reveals that, on aggregate, the most E-mature schools outperformed the less E-mature schools on all three dimensions. This was true for both, primary and secondary schools. Furthermore, nominal differences in the component scores were similar across the three dimensions, although highly E-mature primary schools performed particularly well on the organisational co-ordination dimension when compared to other primary schools with lower total scores.

Figure 2.5 **Primary Schools' E-maturity Scores, by Dimension and Total Score Level (2005)**

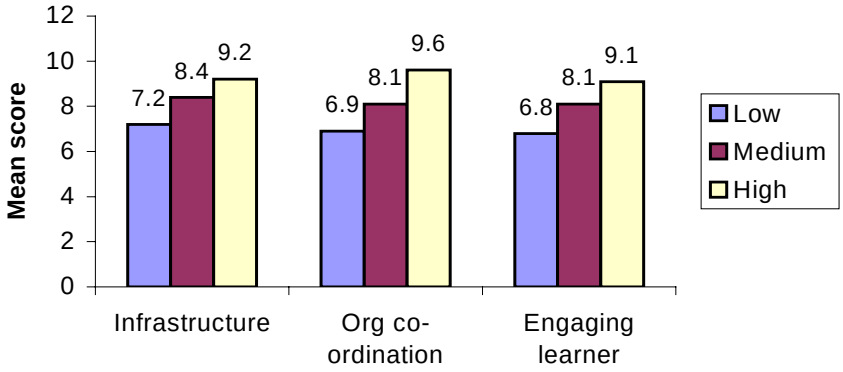
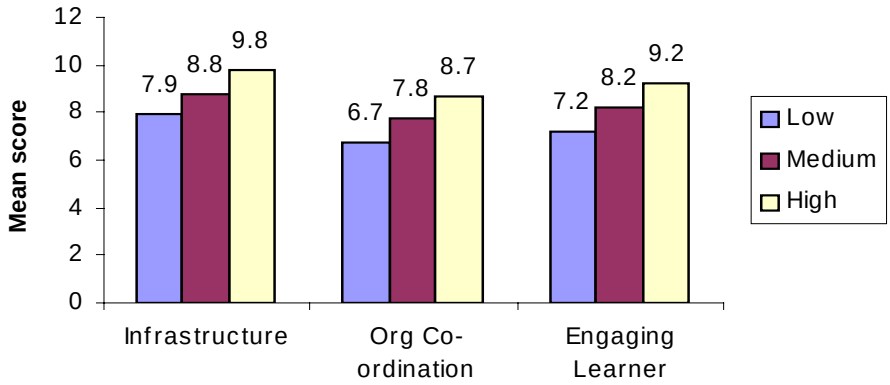


Figure 2.6 **Secondary Schools' E-maturity Scores, by Dimension and Total Score Level (2005)**



Figures 2.7 and 2.8 illustrate the changes in scores for the three E-maturity dimensions between 2002 and 2005 for the three categories of low, medium and high scoring primary and secondary schools. For primary schools, Figure 1.7 reveals a particularly strong increase in scores for organisational co-ordination across all three categories of schools. By comparison, changes among secondary schools were more similar between the three dimensions. For both, primary and secondary schools, the charts illustrate that schools with higher levels of E-maturity in 2005 also experience the proportionately greater change in individual E-maturity dimensions since 2002.

Figure 2.7 **Change in Primary Schools' E-maturity Scores 2002-2005, by Dimension and Total Score Level in 2005**

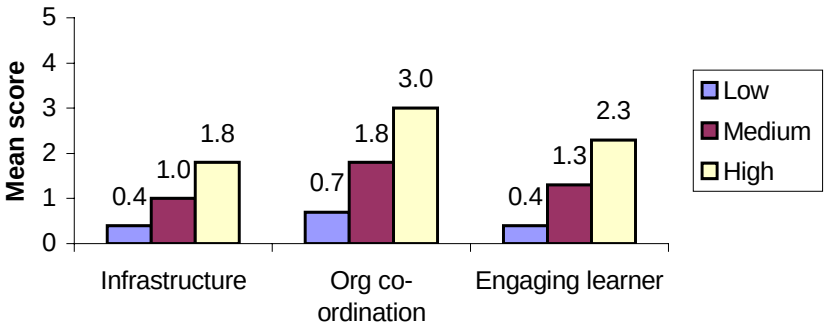
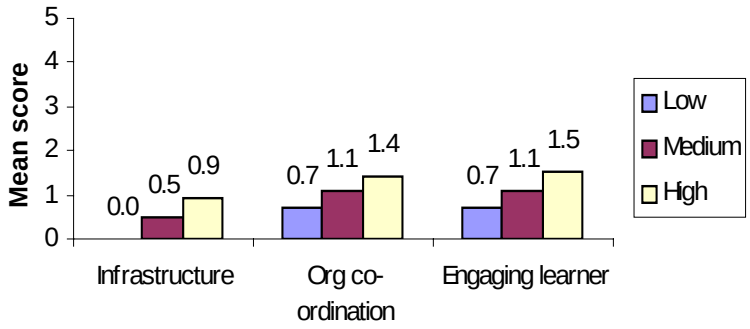


Figure 2.8 Change in Secondary Schools' E-maturity Scores 2002-2005, by Dimension and Total Score Level in 2005



The relatively greater increases in E-maturity scores in the three years to 2005 appeared to have been facilitated by more advantageous conditions that the faster maturing schools had experienced in the base year of 2002. This was the result of regression analysis that compared the relative strength of the relationship between schools' scores on the three E-maturity dimensions in 2002 and their overall E-maturity score in 2005 (Table 2.3).

Among primary schools, E-maturity in 2005 was statistically significantly associated with the schools' performance on infrastructure in 2002. No other E-maturity dimension score for 2002 was independently associated to the aggregate E-maturity score in 2005. In contrast, secondary schools' aggregate E-maturity score for 2005 was strongly statistically associated with their 2002 score on the "engaging the learner" dimension as well as the 2002 infrastructure dimension.

The level of organisation co-ordination of IT issues in 2002 was statistically associated with E-maturity in neither primary nor secondary schools. However, as illustrated earlier (Figures 2.7 and 2.8), primary schools made greatest improvements in their organisational co-ordination of ICT issues, which greatly contributed to their increased E-maturity score. Overall, thus, primary and secondary schools appear to have taken somewhat different paths towards greater E-maturity in the three years to 2005, but have achieved very similar aggregate levels of E-maturity and, perhaps most importantly, similar E-maturity scores on the dimension of 'engaging the learner' (see Section 2.1).

Table 2.3 Association between Aggregate E-maturity in 2005 and E-maturity Dimensions in 2002 - Regression Results for Primary and Secondary Schools

	B	P[2]
Primary Schools		
2002 infrastructure	0.55	0.004 ***
2002 org co-ordination	0.27	0.358
2002 engaging the learner	0.22	0.436
Base	143	
Secondary Schools		
2002 infrastructure	0.42	0.035 **
2002 org co-ordination	0.24	0.312
2002 engaging the learner	0.76	0.000 ***
Base	135	

Note: *** statistically significant at 1% level
** statistically significant at 5% level

[2] "P values indicate the probability that we could have obtained the results shown in the table in the absence of a true association between the variables. The lower this value the more confident we can be in rejecting the null hypothesis of no association and stating that there is a relationship between two variables. For example, a p value of 0.004 indicates that there is a less than 1% chance, given our findings, that there is no association between 2005 e-maturity and 2002 score on the infrastructure dimension for primary schools. This corresponds to a statistically significant finding at the 1% level."

3 E-MATURITY AND SCHOOL CHARACTERISTICS

This section of the report considers the relationship between schools' overall E-maturity score in 2005 and various school characteristics, including the profile of the pupils, the type of school, or the school's participation in government initiatives, such as the Excellence in Cities programme. The characteristics of schools classed as having high, medium or low E-maturity at wave 3 of the COL survey were compared in order to provide a picture of whether high achieving schools differ systematically from those that are less E-mature. Regression analysis was used to examine the strength of association between different characteristics and school's level of E-maturity in 2005. Subsequent analysis looked at change in E-maturity and considered whether schools that had improved their E-maturity position relative to other schools between 2002 and 2005 differed from schools whose position had stayed the same or got worse.

3.1 The Profile of E-mature Schools

Tables 3.1 and 3.2 provide a snapshot comparison of the key characteristics of primary and secondary schools with high, medium, and low levels of E-maturity in 2005. We restrict this presentation to schools that participated in the COL evaluation in both, 2002 and 2005. The school characteristics pertain to early 2006, when the data were obtained from the relevant sources.

Whereas the comparison is mainly descriptive, we specifically analyse the statistical significance of differences in the characteristics of schools with high and with low E-maturity scores in 2005. These two groups of schools will be the focus of additional analysis in later parts of this report, when we seek to draw out the key features of schools that made some of the greatest progress towards E-maturity in recent years.

In brief, the main findings from the comparison of E-maturity scores for primary schools are:

- Schools scoring high on E-maturity had, on average, a significantly higher proportion of pupils with special educational needs.
- School type was associated with E-maturity. High E-maturity schools were significantly less likely to be voluntary aided schools and more likely to be community schools.
- E-mature schools were more likely to be Roman Catholic than low scoring schools, whilst low scoring schools were most likely to have no religious denomination. However, the differences between high and low scoring schools were not statistically significant.
- A higher proportion of schools classed as having high E-maturity were part of Excellence in Cities (14%) compared with low scoring schools (4%). However, the difference between groups was not statistically significant.
- E-mature schools were not significantly different from less E-mature schools in terms of their number of pupils, the proportion of ethnic minority pupils or pupils on free school meals, geographical location or religious denomination.

Table 3.1 Characteristics of Primary Schools by 2005 E-maturity Score

	E-maturity 2005				
	Low	Medium	High	Difference High-Low	Base
Mean					
No of pupils	210	238	253	43	143
% SEN	15	16	22	7 *	143
% Minority ethnic	13	13	19	6	143
% Free school meals	11	13	19	8	143
Percentage of Schools					
Community school	59	40	72	13 *	83
Voluntary aided	29	34	11	-18 *	34
Voluntary controlled	12	25	14	2	23
Church of England	15	15	14	-1	20
Roman Catholic	4	12	15	11	17
Non-religious	81	73	71	-10	106
North of England	27	35	28	1	48
Midlands	38	36	39	1	39
South	35	29	33	-2	56
Excellence in Cities participant	4	7	14	10	12

Note: * statistically significant different between high and low E-maturity schools at 5% level

The main findings for secondary schools were:

- There was a statistically significant relationship between schools' E-maturity score and their subject specialism. Sixty-one percent of the most E-mature schools were specialist science or technology schools compared with only 29% of schools with low E-maturity scores. Thirty-seven percent of schools with low E-maturity scores had no specialism compared with only 12% of high scoring schools. Schools classed as "medium" in terms of E-maturity were most likely to specialise in a non-science subject, e.g. humanities or languages.
- A higher proportion of schools classed as having high E-maturity (48%) were part of Excellence in Cities compared with schools classed as having low E-maturity (31%). However, this difference was not statistically significant.
- E-mature schools were not significantly different from less E-mature schools in terms of their number of pupils; proportion of ethnic minority pupils, pupils on free school meals or with special educational needs; religious denomination, school type, or geographical location.

Table 3.2 Characteristics of Secondary Schools by 2005 E-maturity Score

	E-maturity 2005				
	Low	Medium	High	Difference	Base
Mean					
No of pupils	1091	1017	1092	1	135
% SEN	17	15	18	1	135
% Minority ethnic	18	15	20	2	135
% Free school meals	15	13	18	3	135
Percentage of schools					
Community school	64	62	66	2	85
Foundation school	22	20	22	0	29
Voluntary aided	13	16	11	-2	20
Church of England	12	21	10	-2	20
Roman Catholic	15	8	19	4	19
Non-religious	72	71	70	-2	95
North of England	20	38	30	10	46
Midlands	38	50	35	-3	41
South	43	12	35	-8	48
Science/technology specialism	29	24	61	32 *	51
Other specialism	34	63	27	-7	55
No specialism	37	13	12	-25 *	29
Excellence in Cities (EIC) participant	31	33	48	17	65

Note: * Statistically significant difference at 5% level

3.2 School Characteristics and Progress on E-maturity

In order to establish the extent to which E-maturity scores achieved in 2005 were affected by the school characteristics listed in Tables 3.1 and 3.2, a series of regression analyses were conducted. The analyses controlled for a school's E-maturity score in 2002 and their results, therefore, provide an indication of how school characteristics are related to progress on E-maturity. We also controlled for the number of teacher questionnaires that each school returned (up to 3), as we expected returns might reflect responses or, more generally, attitudes to E-maturity. In the end, this variable proved not to be associated with either.

In interpreting the findings, it must be borne in mind that the school characteristics relate a shortly after the end of the E-maturity observation period rather than coincide with the latter. It is, thus, possible that some of the schools' characteristics may have had changed in the intermittent period, although major changes are unlikely. Regression analysis B-coefficients shown in the following tables that, unlike percentages or number, relate to categorical[3] data are estimated in relation to a comparator variable, which we indicate by placing it in round brackets.

[3] Categorical variables represent types of data that may be divided into groups, for instance, race, sex, age group, educational level, or geography.

The main statistically significant findings from the regression analysis for primary schools are:

- A positive association between pupil numbers and progress on E-maturity. Controlling for their level of E-maturity in 2002, schools with higher numbers of pupils scored higher on E-maturity in 2005.
- A positive association between the percentage of pupils with special educational needs and progress on E-maturity. Controlling for E-maturity in 2002, schools with a higher proportion of SEN pupils scored higher on E-maturity in 2005.

Table 3.3 Association between School Characteristics and E-maturity 2005 – Regression Results for Primary Schools

	B	P
No of pupils	0.01	0.012 **
% SEN	0.10	0.002 ***
% Minority ethnic	-0.003	0.825
% Free school meals	-0.01	0.767
Type of school (Foundation)		
Community/voluntary controlled school	-0.02	0.969
Religion (non-denominational)		
Christian	0.64	0.230
Geography (North)		
Midlands	-0.89	0.208
South	-0.84	0.119
EIC participant (No)		
Yes	0.19	0.821
W1 E-maturity	0.35	0.007 ***
Returned Teachers Questionnaire	0.96	0.130
Base	143	

Note: EIC = Excellence in Cities
***statistically significant at the 1% level
** statistically significant at the 5% level

The main statistically significant findings for secondary schools are:

- A negative association between pupil numbers and progress on E-maturity. Controlling for their level of E-maturity in 2002, schools with higher numbers of pupils scored lower on E-maturity in 2005. This finding is the inverse of that for primary schools and may be a reflection of larger schools already reporting higher E-maturity scores than smaller schools at the start of the observation period. This gave them less scope to improve.[4]
- A positive association between a school specialising in science or technology and progress on E-maturity. Controlling for E-maturity in 2002, schools with specialist science or technology status scored higher on E-maturity in 2005 than schools with no specialism and schools with a specialism in a non-science subject.

[4] It will be recalled that the maximum achievable score on the E-maturity index was 36.

Table 3.4 Association between School Characteristics and E-maturity 2005 – Regression Results for Secondary Schools

	B	P
No of pupils	-0.002	0.011 **
% SEN	-0.001	0.980
% Minority ethnic	0.004	0.707
% Free school meals	-0.001	0.960
Type of school (Foundation or voluntary aided)		
Community/voluntary controlled school	0.56	0.209
Christian	0.21	0.607
Location (North of England)		
Midlands	0.23	0.640
South	-0.24	0.654
EIC participant (No)		
Yes	0.72	0.172
Specialist school (Science & technology)		
Other specialism	-1.15	0.006 ***
None	-2.29	0.002 ***
W1 E-maturity	0.41	0.000***
Returned Teachers Questionnaire	0.43	0.276
Base	135	

Note: *** statistically significant at 1% level
** statistically significant at the 5% level

Comparing Upward Movers vs. Downward Movers

A further analysis compared the characteristics of schools that had enhanced their E-maturity relative to other schools with schools that had not. To do so, we adopted the three-fold division of schools into low, medium and high achievers of E-maturity developed in the earlier analysis depicted in Section 2.3. Schools that had moved from a lower category that they occupied in 2002 to a higher one in 2005 were classified 'upward movers'; likewise, schools that moved from a higher category in 2005 to a lower one in 2002 were 'downward movers'. Schools that remained in the same category in both 2002 and 2005 were 'non-movers'. The analysis compared upward movers with (1) non-movers and (2) downward movers, although our main interest was in the latter comparison. Since mean E-maturity scores increased for both primary and secondary schools between 2002 and 2005, schools marked as 'upward movers' improved in relative terms, i.e. in their ranking with other schools, as well as in terms of their absolute E-maturity scores. The reverse was not necessarily the case for downward movers, which may still have improved their absolute scores, as non-movers would also typically have. By pitching upward movers against downward and non-movers, we were able to draw out further school features associated with particularly strong positive development towards greater E-maturity.

For both, primary and secondary schools, the logistic regressions found statistically significant differences in the characteristics of upward movers compared to downward movers (Tables 3.5 and 3.6; first results column). In addition, for primary schools, there were also statistically significant differences between upward movers and non-movers (Table 3.5; second results column).[5]

Turning first to primary schools and the comparison of upward and downward movers, the statistically significant results are:

- The higher the number of pupils at the school, the more likely the school was to be an upward mover. Although the odds ratio itself was small (1.01), because the odds increased per pupil, the school size effect was nevertheless substantial.
- The higher the proportion of pupils with special educational needs, the more likely the school was to be an upward mover.
- The odds of being an upward mover rather than a downward mover were reduced for schools that were part of the Excellence in Cities programme. It is unclear from the data why this should be the case.

The comparison of upward movers and non-movers among primary schools yielded somewhat different results:

- Primary schools were less likely to be upward movers than non-movers the larger the school.
- A greater proportion of pupils from ethnic minorities increased the odds of a primary school being an upward mover rather than a non-mover.
- A larger proportion of pupil eligible for free school meals was associated with reduced odds of the school being an upward mover rather than a non-mover.

[5] Logistic regressions estimate ratios of two odds: the odds of an events happening rather than not happening for one comparison group, and the odds of an events happening rather than not happening for the other comparison group, given certain characteristics. In this report, the two comparison groups are reported in the top row of the tables. For instance, the two comparison groups in Table 2.5 are upward movers and downward movers (and, in the second half of the table, upward movers and non-movers). The characteristics, conditional upon which the odds are estimated, are identified in the left-hand column. An odds ratio of '1' indicates identical odds, whereas a value greater (lower) than '1' indicates greater (lower) odds for the relevant comparison group to experience an event rather than not to experience it.

Table 3.5 Association between school characteristics and progress on E-maturity - logistic regression results for primary schools

	Upward Movers vs. Downward Movers		Upward Movers vs. Non-Movers	
	Odds Ratio	P	Odds ratio	P
No of pupils	1.01	0.002 ***	0.995	0.036 **
% SEN	1.10	0.029 **	0.979	0.536
% Minority ethnic	1.01	0.709	1.03	0.017 **
% Free school meals	1.00	0.966	0.949	0.026 **
Type of school (Foundation or voluntary-aided)				
Community/voluntary controlled school	1.03	0.963	0.976	0.972
Religion (non-denominational)				
Christian	0.76	0.681	0.840	0.767
Location (North)				
Midlands	0.85	0.864	0.813	0.749
South	0.45	0.318	0.371	0.114
EIC participant (No)				
Yes	0.13	0.065 *	1.89	0.506
Returned Teachers Questionnaire	2.23	0.308	3.44	0.115
Base	82		106	

Note: *** statistically significant at 1% level
** statistically significant at the 5% level
* statistically significant at the 10% level

For secondary schools, statistically significant differences were only found in the comparison of upward movers and downward movers. The results revealed:

- A greater number of pupils reduced the odds of a school being an upward mover rather than a downward mover.
- The higher the proportion of ethnic minority pupils, the greater the school's odds of being upward mover.
- Christian secondary schools were more likely to be upward movers than non-religious schools.
- Schools not specialising in any subject were less likely than schools specialising in science or technology to be upward movers.

Table 3.6 Association between school characteristics and progress on E-maturity - logistic regression results for secondary schools

	Upward Movers vs. Downward Movers		Upward Movers vs. Non-Movers	
	B	P	B	P
No of pupils	0.998	0.019 **	1.00	0.262
% SEN	0.95	0.270	1.00	0.989
% Minority ethnic	1.03	0.092 *	1.00	0.870
% Free school meals	1.02	0.642	1.00	0.934
Type of School (Foundation)				
Community/voluntary controlled school	2.18	0.335	1.63	0.484
Religion (Non-denominational)				
Christian	5.28	0.013 **	1.13	0.831
Location (North of England)				
Midlands	2.44	0.326	1.24	0.753
South	0.52	0.524	0.77	0.710
EIC participant (No)				
Yes	0.30	0.210	1.14	0.838
Specialist school (Science/technology)				
Other specialism	0.53	0.368	0.95	0.929
None	0.14	0.078 *	2.38	0.303
Returned Teachers Questionnaire	1.10	0.890	1.57	0.444
Base	67		101	

Note: ** statistically significant at 5% level
* statistically significant at 1% level

The analyses thus led to the identification of school characteristics additional to those highlighted by the initial regression analysis of nominal changes in E-maturity. Besides indicators of school size and proportion of students with special educational needs (SEN), in secondary schools, religious (Christian) denomination and specialist school status (in science and technology) increased the likelihood of schools having improved their E-maturity in absolute and in relative terms rather than to have dropped behind other E-maturing schools. For primary schools, the non-participation in the Excellence in Cities programmes was the principal additional factor associated with absolute and relative improvements in E-maturity.

PART 2

4 E-MATURITY AND THE PERFORMANCE OF SCHOOLS AND THEIR PUPILS

The aim of the second stage of the analysis, written up in this second part of the report, is to relate changes in schools' E-maturity to schools' performance. In other words, we want to observe the strength of association, if any, between E-maturity (and change in E-maturity) and attainment levels in schools.

For the analysis, pupil attainment data, received from the Department for Education and Skills (DfES) and pertaining to the schools in sample, were appended to the school data set. Attainment data were obtained for Key Stages 2 (primary schools) and Key Stages 3 and 4 (secondary school). Data covered school performance from the school year 2001/02 up until 2004/05. Details on the different measures of school performance used can be found in the introduction to the report.

In order to assess the association between E-maturity and school attainment, two types of analysis were undertaken. First, we conducted bivariate regression analyses, which measured the strength of association between schools' E-maturity score and one of a number of performance indicators in a given year. Second, we were concerned with establishing how change in schools' E-maturity between the COL evaluation waves might have been associated with school performance. To do so, regression analysis was used to measure the association between changes in E-maturity scores and performance data. We also reverted to our tri-partite division of low, medium and high performing schools that was used in Stage 1 of the analysis to determine the distinctive characteristics of 'upward movers' on the E-maturity scale of primary and secondary schools. Here, we used logistic regression analysis of this division to observe associations with schools performance. For the most part, these analyses proved to add little to the findings of the regression analyses, and, for this reason, we limit reporting of their results to reproducing the logistic regression tables in Appendix C.

4.1 Some Caveats

The main focus of these analyses was on changes in E-maturity between waves 1 (2002) and 3 (2005) of the COL evaluation, although a separate analysis was also undertaken for changes between waves 1 and 2 (2003). As was noted earlier in discussing Stage 1 of our analyses, changes in E-maturity scores between waves 1 and 2 of the COL evaluation were rather small, which suggested the focus should be on changes in E-maturity between waves 1 and 3. Although, as is apparent from Table 4.1, aggregate changes in E-maturity scores even during this longer time period were relatively small. Individual schools, however, made more substantive advances towards E-maturity, which provided greater scope for analysis than a focus on waves 1 and 2 would have offered.

We nevertheless analysed changes in E-maturity and their relationship with performance indicators in waves 1 and 2 because we wanted to observe the effect of allowing for a time lag on the association between the two types of indicators. Specifically, it was assumed that improvements in E-maturity at schools would not immediately be associated with performance changes, but that the latter would take some time to emerge as pupils began to benefit from IT. Because performance data are not yet available for the school year 2005/06 it was not possible to allow for E-maturity to 'bed in' and observe associations with performance data following wave 3 of the COL evaluation. This was, however, possible by using COL evaluation data for wave 1 (2002) and wave 2 (2003), because we had performance data for two years after completion of wave 2. This said, the comparison was hampered by the shorter period of change in E-maturity that was covered and the consequent smaller change that was observable.

Performance data are frequently highly correlated, which precludes their concurrent use in regression analysis and is also likely to produce the same analysis results for different performance indicators. For this reason, we have restricted the analyses to variables, which we considered most valuable and insightful in the broader context of the study, removing other variables from the analyses[6]. Because the remaining variables were statistically highly correlated - as we show in Tables A.2 and A.3 in Appendix B , separate regression and logistic regression analyses were conducted for each of the relevant indicators.

As before, we report separately for primary and secondary schools, beginning with the former, and focussing initially on changes between waves 1 and 3. All results are shown for analyses after controlling for the school characteristics discussed in Part 1. The school variables are not shown in the Tables reproduced here, but where the inclusion of school characteristics changed the statistical significance of analysis results, this will be pointed out.

Table 4.1 below summarises key statistics for the first (2002) and the third (2005) waves of the COL evaluation used in the following analyses. With the exception of the mean percentage of pupils in secondary schools obtaining A* - C grades and the mean percentage of authorised absences in both primary and secondary schools, there were no substantive changes in performance rates recorded at the sampled schools between 2002 and 2005. Authorised absences decreased in both types of school, while the proportion of A*-C grades in secondary schools increased. Note that there were no data available for primary schools' Value Added between KS1 and KS2 in 2002.

In the following section, we turn to reporting the findings from the analyses of the association between (changes in) E-maturity and performance, beginning with primary schools.

[6] For instance, average point scores and aggregate percentage of pupils obtaining Level 4+ across three subjects were highly statistically correlated, and only the former was included in the analysis. As in other similar instances, selecting the alternative (latter) variables would have yielded largely identical results, certainly with respect to statistical significances.

Table 4.1 School Performance Data Background Statistics

	2002	2005
Primary Schools		
KS2 Average Points (Mean)	27.7	28.0
Min	22.6	22.6
Max	31.9	31.6
KS1-KS2 Value Added (Mean)	N/A	100.3
Min	N/A	97.4
Max	N/A	103.1
% Authorised Absences (Mean)	5.3	4.7
Min	3.0	1.2
Max	11.0	8.7
E-maturity Score (Mean)	20.5	25.0
Min	15.3	15.6
Max	26.3	31.6
Secondary Schools		
KS3 Average Points (Mean)	33.9	34.7
Min	26.8	27.5
Max	45.3	44.7
KS2-KS3 Value Added (Mean)	99.9	99.7
Min	96.3	96.7
Max	104.0	102.9
% A*-C (Mean)	49.9	56.6
Min	6.0	18.0
Max	100	100
% A* - G (Mean)	90.7	91.9
Min	68.0	60.0
Max	100	100.0
KS3-KS4 Value Added (Mean)	98.4	994.6
Min	92.4	937.0
Max	106.8	1064.2
% Authorised Absences (Mean)	7.7	6.6
Min	3.5	2.3
Max	13.7	11.5
E-maturity Score (Mean)	22.1	24.9
Min	15.0	19.6
Max	32.1	30.7

Base: Primary and secondary schools participating in both wave 1 (2002) and wave 3 (2005) of the Curriculum Online evaluation

4.2 Findings - Primary Schools

Analyses of E-maturity and school performance indicators at primary school level found no evidence of a statistically significant association. After controlling for school characteristics, pupils' average points scores and the percentage of authorised absences in 2002 and 2005 and the respective E-maturity scores were not statistically related (Tables 4.2 and 4.3).

Table 4.2 Association Between Performance Indicator in Year 2002 and E-maturity at Wave 1 (2002) - Multivariate Regression Results for Primary Schools

	B	P
Average Points 2002	0.13	0.422
% Authorised Absences 2002	0.04	0.730
Base	121	

Note: Results after controlling for school characteristics.
Separate regressions run for each indicator.

Table 4.3 Association Between Performance Indicator in Year 2005 and E-maturity at Wave 3 (2005) - Multivariate Regression Results for Primary Schools

	B	P
Average Points 2005	-0.01	0.980
Value added 2005	-0.12	0.649
% Authorised Absences 2005	-0.22	0.637
Base	121	

Note: Results after controlling for school characteristics.
Separate regressions run for each indicator.

The association between performance indicators and the change in E-maturity scores was estimated by calculating the difference between scores in 2002 and 2005, and regressing these against the performance indicators. Because it may conceivably be the case that different initial E-maturity scores have differential effects on the propensity to improve on these scores in later years, the regression analyses also controlled for the initial score achieved in 2002.[7] The high level of statistical significance between the nominal change in E-maturity and the E-maturity score at wave 1 of COL evaluation (2002) confirmed this expectation; E-maturity at the beginning of the analysis period was the strongest predictor of change in E-maturity over the following three years. By including the 2002 E-maturity value, we effectively created a statistical 'level playing field' between schools.

The analysis again found no evidence any association between E-maturity scores and pupils' average attainment scores during this period (Table 4.4). However, change in E-maturity was statistically significantly and inversely associated with the percentage of authorised absences in 2002. This suggests that, on average, schools that achieved greater changes in E-maturity originally reported lower percentages of authorised absences; on average, a one-point increase in E-maturity scores between 2002 and 2005 was associated with a 0.4 percentage points lower rate of authorised absences in 2002. No such association was discernible for absences in 2005, indicating that schools with higher authorised absence rates were catching up in terms of their E-maturity.

We conducted a separate logistic regression analysis, which compared schools that improved their position in the tertile distribution[8] of E-maturity scores between 2002 and 2005 with schools that had maintained their position or had dropped back. This revealed no statistical evidence of an association between tertile positions and performance indicators. The results are shown in Table A.4 in Appendix C.

[7] As before, the analyses also controlled for school characteristics.
[8] Distinguishing between low, high and medium performers. See Part 1.

Table 4.4 Association between Performance Indicators and Change in E-maturity 2002 to 2005 - Multivariate Regression Results for Primary Schools

	B	P
W1 E-maturity	-0.60	0.000 ***
Average Points 2002	-0.15	0.488
Average Points 2005	-0.002	0.994
W1 E-maturity	-0.61	0.000 ***
% Authorised Absences 2002	-0.41	0.030 **
% Authorised Absences 2005	-0.29	0.374
Base	121	

Note: Results after controlling for school characteristics.
Separate regressions run for each indicator.
*** statistically significant at 1% level
** statistically significant at 5% level

4.3 Findings – Secondary Schools

In comparison to primary schools, a larger set of performance indicators was available for investigating associations with E-maturity scores in secondary schools. The analyses highlighted a number of positive and statistically significant associations between scores and performance indicators.

In 2002, secondary schools' E-maturity scores were statistically significantly associated with the average points scores at Key Stage 3, the proportion of pupils achieving A* - C grades at Key Stage 4 and the percentage of authorised absences. The first two associations were positive, the last one negative. The negative (or inverse) relationship suggests that, in 2002, schools with higher E-maturity scores reported, on average, a lower proportion of their pupils with authorised absences. Unlike the coefficient for the Key Stage 4 indicator, the coefficients for Key Stage 3 average points and for authorised absences were comparatively large. For each point increase (decrease) in E-maturity in 2002, the average Key Stage 3 point score increased (decreased) by 0.19 points, while the proportion of authorised absences decreased (increased) by 0.25 percentage points. In all three instances, the findings suggest that, on average, better-performing schools also recorded higher levels of E-maturity as measured by our index.

Table 4.5 Association Between Performance Indicator in Year 2002 and E-maturity at Wave 1 (2002) - Multivariate Regression Results for Secondary Schools

	B	P
KS3 Average Points 2002	0.19	0.068*
KS2-3 value added 2002	0.16	0.480
% A* - C KS4 2002	0.05	0.001 ***
% A* - G KS4 2002	0.04	0.350
KS3-4 value added 2002	0.14	0.134
Authorised Absences 2002	-0.25	0.064 *
Base	131	

Note: Results after controlling for school characteristics.
Separate regressions run for each indicator.
*** statistically significant at 1% level
** statistically significant at 5% level
* statistically significant at 10% level

The average Key Stage 3 point score for 2002 and the percentage of pupils achieving A*-C grades at KS4 2002 only turned statistically significant after including the school characteristics as control variables in the regression analysis. In contrast, the variable measuring the percentage of authorised absences in 2002 was statistically significant in the initial models that did not control for school characteristics as well as the final model shown in Table 4.5.

Table 4.6 illustrates similar findings with respect to the association between E-maturity scores at wave 3 of the COL evaluation in 2005 and the three performance indicators pertaining to that year. Average point scores achieved by pupils at Key Stage 3 and the proportion of pupils achieving A* - C grades at Key Stage 4 were again positively and statistically significantly associated with E-maturity scores, whereas the percentage of authorised absences was inversely related to E-maturity scores. In addition, the value added by schools between Key Stages 3 and Key Stages 4 in 2005 was statistically significantly associated with E-maturity. As in 2002, thus, schools reporting higher E-maturity scores also reported higher attainment levels and lower absences.

Table 4.6 Association Between Performance Indicator in Year 2005 and E-maturity at Wave 3 (2005) - Multivariate Regression Results for Secondary Schools

	B	P
KS3 Points 2005	0.25	0.018 **
KS2-3 value added 2005	0.06	0.823
% A* - C KS4 2005	0.04	0.002 ***
% A* - G KS4 2005	0.07	0.139
KS3-4 value added 2005	0.03	0.032 **
% Authorised Absences 2005	-0.24	0.066 *
Base	131	

Note: Results after controlling for school characteristics.
Separate regressions run for each indicator.
*** statistically significant at 1% level
** statistically significant at 5% level
* statistically significant at 10% level

Average point scores at Key Stage 3 and the percentage of authorised absences become statistically significantly associated with E-maturity scores only after the inclusion of the school characteristics in the regression model. No other variables were affected.

Given these preliminary results from the cross-sectional analysis of the association between E-maturity and performance indicators in 2002 and 2005, it is unsurprising to see that the same measures were statistically significantly associated with changes in E-maturity between 2002 and 2005 (Table 4.7). Average points at Key Stage 3 in 2002 and 2005, and the percentage of pupils achieving A* - C grades at Key Stage 4 in 2002 and 2005 were all statistically significantly associated with increases in E-maturity during that time. However, the association between A* - C grades in 2002 and E-maturity change was only marginally statistically significant.

Table 4.7 Association between Performance Indicators and Change in E-maturity 2002 to 2005 - Multivariate Regression Results for Secondary Schools

	B	P
W1 E-maturity	-0.64	0.000 ***
KS3 Points 2002	-0.43	0.025**
KS3 Points 2005	0.52	0.010**
W1 E-maturity	-0.60	0.000 ***
KS23 Value added 2002	-1.00	0.679
KS23 Value added 2005	-0.04	0.866
W1 E-maturity	-0.63	0.000 ***
% A* - C KS4 2002	-0.04	0.070 *
% A* - C KS4 2005	0.06	0.005 ***
W1 E-maturity	-0.61	0.000 ***
% A* - G KS4 2002	0.05	0.252
% A* - G KS4 2005	0.01	0.916
W1 E-maturity	-0.63	0.000 **
KS34 Value added 2002	0.06	0.534
KS34 Value added 2005	0.02	0.199
W1 E-maturity	-0.60	0.000 ***
% Authorised Absences 2002	-0.06	0.687
% Authorised Absences 2005	-0.24	0.085 *
Base	131	

Note: Results after controlling for school characteristics. Separate regressions run for each indicator.
*** statistically significant at 1% level
** statistically significant at 5% level
* statistically significant at 10% level

The percentage of authorised absences was inversely statistically associated with increased E-maturity, but only with respect to absence statistics relating to 2005. Neither the percentage of pupils achieving A* - G grades at Key Stage 4, nor the schools' value added between Key Stages 3 and 4 was statistically related to E-maturity.

In the case of the average points score achieved at Key Stage 4 and the proportion of pupils achieving A* - C grades at Key Stage 4, the coefficients for 2002 and 2005 change signs from negative to positive.[9] The regression analyses measure the association between independent variables (here: scores and grades) and the dependent variable (here: the change in E-maturity scores) after controlling for all other variables' influence. This result thus shows that, all else equal, increases in E-maturity were associated with lower average

[9] This is also in contrast to the results reported in Tables 4.5 and 4.6, where the coefficients for both variables are always positive.

scores and grades in 2002, but higher scores and grades in 2005. The 'best' performers in terms of improved E-maturity, therefore, were those with lower performance scores at the start, and higher performance scores at the end of the observation period.

The logistic regression analyses that compared the performance indicators of schools, which, between 2002 and 2005, moved upwards in the tertile distribution of E-maturity scores with those that moved downwards in the distribution confirmed these findings only for A*- C grades in 2002 (see Table A.5 in Appendix C).

Overall, the analyses suggest a positive association between improvements in E-maturity and improvements in performance during the period from 2002 to 2005 in secondary schools.

4.4 Additional Analysis of Waves 1 and 2

The above analyses have given some indication of the associations between E-maturity or changes in E-maturity and the performance of schools in terms of their pupils' attainment and the prevalence of authorised absences. The analyses assumed that the comparisons of the indicators were not substantially affected by differences in the timing of their measurements.

However, it would be more realistic to expect a time lag to occur between schools achieving a given level of E-maturity or improvement in E-maturity and associated changes in performance indicators. Unfortunately, in the absence of performance indicators for more recent years, this assumption could not be tested for E-maturity scores and change values in 2005. However, it is possible to test the assumption using data from the second wave of the COL evaluation, conducted in 2003, since performance data are available for 2004 and 2005 as well as 2003. This said, any analysis of the association between change in E-maturity and performance indicators is hampered by the slow change in E-maturity. Between 2002 and 2003, E-maturity scores among the primary schools in the sample increased from, on average, 20.5 to 22.2; while they increased from 22.3 to 23.1 for secondary schools. Given these small changes, it is less likely that association with performance indicators will emerge.[10] Moreover, E-maturity scores continued to change after 2003 (wave 2) and up to the years for which performance data were available. Insofar as the size and timing of these changes varied between schools, it is conceivable that these variations would have affected estimates of the association between changes in E-maturity and performance indicators beyond 2003.

Tables 4.8 and 4.9 summarise the results of the multivariate regression analyses for primary and secondary schools respectively. For greater readability, we have only re-produced statistically significant associations. Neither for primary nor for secondary schools do consistent statistical associations emerge.

For primary schools, average points scores achieved by pupils at Key Stage 2 and the percentage of authorised absences were statistically significantly associated with changes in E-maturity in the year to 2003. For subsequent years, only the percentage of authorised absences in 2005 re-emerges with a statistically significant association with E-maturity change. In both instances, the association is negative, or inverse, that is, a positive change in E-maturity was associated with lower absence rates.

[10] The changes were equivalent to 29 percent and 39 percent of the total 2002-to-2005 change in average E-maturity scores for primary and secondary schools, respectively.

Table 4.8 Association between Performance Indicator in Various Years and Change in E-maturity between 2002 and 2003 - Multivariate Regression Results for Primary Schools

	B	P
2003		
W1 E-maturity	-0.53	0.000 ***
KS2 Average Points 2002	0.14	0.510
KS2 Average Points 2003	-0.36	0.038 **
W1 E-maturity	-0.58	0.000 ***
% Authorised Absences 2002	-0.02	0.908
% Authorised Absences 2003	-0.30	0.078 *
2004		
2005		
W1 E-maturity	-0.56	0.000 ***
% Authorised Absences 2002	-0.05	0.748
% Authorised Absences 2005	-0.49	0.054 *
Base	120	

Note: Results after controlling for school characteristics.
Separate regressions run for each indicator.
*** statistically significant at 1% level
** statistically significant at 5% level
* statistically significant at 10% level

For secondary schools, the findings are similarly inconclusive. The analyses established statistically significant associations between E-maturity change up to 2003 and the percentage of authorised absences. However, the association with absence rates in 2003 is positive, whereas previous analysis of changes in E-maturity and performance indicators over the longer period up to 2005 suggested the association was negative. In addition, the percentage of pupils achieving grades A* to G at Key Stage 4 in 2003 emerges as statistically significantly associated with E-maturity change. This is the only occasion that this indicator was found to be associated with E-maturity.

Neither indicator is statistically significantly associated with change in E-maturity in subsequent years. Instead, average points achieved at Key Stage 3 in 2004 and the schools' value added between Key Stages 3 and 4 in 2004 are both positively associated with E-maturity change recorded up to 2003. No performance indicator pertaining to the year 2005 was statistically significantly associated with E-maturity change between 2002 and 2003.

Table 4.9 Association between Performance Indicator in Various Years and Change in E-maturity between 2002 and 2003 - Multivariate Regression Results for Secondary Schools

	B	P
2003		
W1 E-maturity	-0.21	0.025**
% A* - G KS4 2002	0.09	0.101
% A* - G KS4 2003	-0.13	0.029 **
W1 E-maturity	-0.25	0.006 ***
% Authorised Absences 2002	-0.28	0.070 *
% Authorised Absences 2003	0.31	0.075 *
2004		
W1 E-maturity	-0.23	0.010 **
KS3 Points 2002	-0.11	0.369
KS3 Points 2004	0.16	0.010 **
W1 E-maturity	-0.24	0.008 ***
KS3-KS4 Value Added 2002	-0.11	0.253
KS3-KS4 Value Added 2004	0.03	0.068 *
2005		
Base	119	

Note: Results after controlling for school characteristics.
Separate regressions run for each indicator.
*** statistically significant at 1% level
** statistically significant at 5% level
* statistically significant at 10% level

5 SUMMARY AND CONCLUSIONS

This study analysed data from three waves of the evaluation of the Department for Education and Skills' Curriculum Online (COL) initiative to measure and record the levels and intensity of use of ICT in primary and secondary school. The extent to which schools use ICT is referred to as E-maturity. An E-maturity index was constructed on the basis of responses by schools and school teachers to COL evaluation questions about the presence and quality of ICT resources in schools and their use inside and outside classrooms, and for preparing lessons. For each school an E-maturity score was calculated based on these responses. Change in these scores between 2002 and 2005 were studied and associations with school performance indicators analysed.

5.1 E-maturity and E-maturity Change between 2002 and 2005

The analysis determined that levels of e-maturity in schools had increased significantly between 2002 and 2005. The largest changes were seen in primary schools, which, despite lagging behind secondary schools in 2002, by 2005 had effectively achieved levels of e-maturity equal to those of secondary schools (24.8 and 24.9 points respectively). Schools with high levels of e-maturity overall outperformed schools with lower scores on all three dimensions that made up the e-maturity index: infrastructure and resources, organisational co-ordination, and engaging the learner. In primary schools, e-maturity in 2005 was positively associated with the school's previous score on the infrastructure dimension in 2002. In secondary schools, e-maturity in 2005 was positively associated with the school's previous performance on infrastructure and engaging the learner.

Schools' organisational features and their workforce's attitudes towards ICT at the start of the observation period appeared not to influence their overall e-maturity rating in 2005. Improvements in e-maturity, therefore, were above all associated with resource upgrades and more intensive use of resources in the classroom, rather than by the teachers' and the schools' own (ability to) use and management of these resources.

Primary schools, on average, achieved higher e-maturity scores than secondary schools on the organisational co-ordination dimension of the e-maturity index, whereas secondary schools tended to be better equipped in terms of their ICT infrastructure. These were also the dimensions on which each school type improved most strongly in the three years to 2005. There was no statistically significant difference between primary and secondary schools' scores on the 'engaging the learner' dimension.

In both primary and secondary schools, changes in E-maturity were associated with specific school characteristics. E-maturity scores for 2005 increased in primary schools with the size of the school and the proportion of students with special educational needs, as well as the E-maturity baseline score in 2002. In secondary schools, the baseline score for 2002 also drove E-maturity scores in 2005. In addition, a major positive influence on a secondary school's E-maturity score in 2005 was their status as a specialist school: specialist science and technology secondary schools were most likely to achieve high E-maturity scores.

Additional analysis of schools that improved their E-maturity rank (distinguishing between low, medium and high performers) from 2002 and 2005 highlighted further distinguishing features. Primary schools not participating in the Excellence in Cities programme were more likely than other schools to have moved up rather than down the tertile ranking between 2002 and 2005. The same was true for secondary schools of Christian denomination (when compared to non-denominational schools).

5.2 E-maturity and School Performance

The analyses of E-maturity in primary schools revealed no association between E-maturity and performance indicators in either 2002 or 2005, although the analysis of change in E-maturity suggested an inverse relationship between this indicator and the percentage of authorised absences in 2002. In other words, primary schools that recorded the greatest increase in E-maturity over the three-year observation period started with statistically significantly lower authorised absence rates than other schools, but they did not record sustained lower authorised absence rates in the final year of the observation.

In contrast, for secondary schools, the analyses revealed a statistically significant association between E-maturity and performance in terms of lower absence rates, higher KS3 average points and higher percentage of A* - C grades at KS4 in both 2002 and 2005. In addition, more E-mature secondary schools were also statistically significantly likely to report greater KS3 - KS4 value added in 2005, although not in 2002. Thus, 'better' performing schools, not only scored highly on the E-maturity index in 2005 but, in so far as they did so in 2002, were prominent among the early adopters of E-maturity practices.

The analyses of E-maturity change confirmed that improvements on this score were statistically significantly related to lower absence rates in 2005, KS3 point averages and the proportion of pupils achieving A* - C grades at KS4. Greater improvements in E-maturity on the latter two indicators were associated with lower initial performance scores in 2002 and higher scores in 2005, indicating a statistically significant positive relationship between E-maturity and performance change.

These results would suggest a link between performance and E-maturity, although it cannot yet be concluded with certainly that this link is direct or causal. In the light of more inconclusive findings from the analysis of change between waves 1 and 2, some caution must be due before drawing such conclusion. The analysis of change between waves 1 and 2 revealed that associations between E-maturity change and performance indicators varied with time. This may have been a reflection of continued changes in E-maturity that schools experienced after 2003 and which likely affected performance data for later years. It is furthermore conceivable that there may be further intermediate factors that affected school performance, but that this study did not capture despite controlling for some school characteristics. An example of such an intermediate factor may be the managerial style and ethos of a school. Whereas it may not be possible to enhance the analysis by including further intermediate variables, a repeat of the present analysis using performance data for 2005/06, as soon as they become available, should help to further improve our understanding of the association between E-maturity and school performance. Additional interrogation of teacher and school-level responses may also help to shed further light on the association of E-maturity and school performance.

BIBLIOGRAPHY

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APPENDIX A E-MATURITY INDICATORS

Indicators of E-maturity were selected from the COL evaluation questionnaire with the help of a team of experts, which included BECTA staff and school teachers. To create an index of E-maturity, each indicator was assigned a score ranging from one to three, with three representing the most "E-mature" position.

Assigning each indicator the same score range from 1 to 3 ensured that all indicators had equal weight in the construction of the overall index and no one indicator had an excessive influence. If original questions had more than three response categories, appropriate categories were combined. Details of how scores were assigned to each indicator are given in Table A.1 below.

If more than one response to the same question was used as the initial basis for calculating the indicator (e.g. if schools were asked separately about multiple types of resources, and the objective was to capture all responses), each response was scored from 1 to 3. The score was then averaged across responses to ensure that the final score remained within the one to three range.

Similarly, where indicators were taken from the teacher questionnaire, responses for each teacher within a school were scored from one to three. School level scores on these indicators were then calculated by averaging scores across responses from teachers of the three core subjects – maths, science and English. There were a number of schools that did not return questionnaires from all three core subject teachers. In such cases, an average score was calculated based on those questionnaires that were returned.

There were no statistically significant differences in E-maturity scores between schools that returned all three questionnaires and those that returned fewer than three. However, as a safeguard against possible bias resulting from differences in the amount of data available, a control variable indicating schools where fewer than three teacher questionnaires were returned was included in all multivariate analysis.

Apdx Table A.1 E-maturity: Dimensions and Survey Questions

***Dimensions* and Survey Questions**	**Scoring**
Infrastructure and Resources	
Pupil: Computer (desktop+laptop) ratio Pupil: interactive whiteboard ratio	For each ratio 1=schools in tertile with highest pupil:resource ratio 2= schools in middle tertile 3= schools in tertile with lowest pupil:resource ratio Final score = averaged score over 2 ratios
How would you rate the school's internet connection in terms of speed? - Fast enough for all or most of our requirements - Fast enough for some of our requirements - Not fast enough for our requirements	1= not fast enough 2 = fast enough for some 3 = fast enough for most/all
How many computers in the school are linked to a network? - All - More than half - Around half - Less than half - None	1= none/less than half 2= around half/more than half 3 = all
How well do current levels of funding meet the school's needs for technical support and training? - More funding than we need - About the right amount of funding - Less funding than we need	1=less than need 2 = about right 3=more than need

Apdx Table A.2 E-maturity: Dimensions and Survey Questions (cont.)

***Dimensions* and Survey Questions**	**Scoring**
Organisational co-ordination	
How important a role would you say ICT plays in teaching at your school for the following? – Very important - Quite important - Not very important - Not at all important Question asked of different key stages and subjects	Each subject in each key stage scored so: 1= not very/at all 2=quite 3=very Final score = averaged scores for maths, English and science at KS2 (primary) and KS4 (secondary)
Overall, how confident would you say teachers at the school are in the use of ICT in delivering the school curriculum? - Very confident - Quite confident - Not very confident - Not at all confident	1= Not very/at all 2= quite 3= very
In planning the content of lessons for your subject proportionately how much use is made of digital resources (e.g. web-based content, software packages)?	For each teacher scored so: 1=<25% 2=25-49% 3=50% or more Final score = averaged scores for teachers of 3 core subjects
Which of the following resources are available for use in lessons for your subject? Desktop computers, laptops, interactive whiteboards - Dedicated resources available for subject - Only shared resources available for subject - Not available	Each resource scored so: 1= not available 2=shared 3=dedicated for subject Final score= averaged scores across 3 resources

Apdx Table A.3 E-maturity: Dimensions and Survey Questions (cont.)

***Dimensions* and Survey Questions**	**Scoring**
Engaging the Learner	
For each available please rate the fitness for purpose of resources available Desktops, laptops, interactive whiteboards - Very good - Quite good - Not very good - Not at all good - Not available	Each resource scored so: 1=not good/not available 2= quite good 3=very good Final score = averaged scores across 3 resources
How frequently are the following resources used in lessons for your subject? Computer packages, Internet based resources, subject specific software applications - In all/most lessons - In more than half of lessons - In around half of lessons - In less than half of lessons - Rarely/never - Not available	Each resource scored so: 1= rarely/not available 2= less than half of lessons 3= half or more Final score = averaged scores across 3 resources
How important a role does ICT play in teaching and learning for your subject? - Very important - Quite important - Not very important - Not at all important	1 = not very/ at all 2= quite 3=very Question asked of all Key Stages Look just at KS2 for primary and KS4 for secondary
Are ICT facilities available for pupil use outside lessons in any of the following ways? - Breakfast clubs - Lunchtime clubs - After-school clubs - Informal access before school - Informal access at lunchtimes/breaks - Informal access after school - None of these	Access divided into formal (clubs) and informal. For each score: 1= none 2= at least one 3 = all three Final score = averaged score across 2 types of access.

APPENDIX B CORRELATIONS BETWEEN PERFORMANCE INDICATORS

Apdx Table A.4 Correlations of Performance Indicators - Primary schools

	Average Points 2002	Absences 2002	Average Points 2005	Value Added 2005
Average Points KS2 2005	0.73 *			
Value added KS2 2005			0.70*	
Absences 2005		0.13	-0.51*	-0.17

* statistically significant at 5% level

Apdx Table A.5 Correlations of Performance Indicators - Secondary schools

	KS3 2002	KS3 VA 2002	A*-C 2002	A*-G 2002	KS4 VA 2002	Abs 2002	KS3 2005	KS3 VA 2005	A*-C 2005	A*-G 2005	KS4 VA 2005
KS3 2005	0.94 *										
KS3 VA 2005		0.69 *					0.76				
A*-C 2005			0.89 *				0.86	0.66 *			
A*-G 2005				0.79 *			0.74	0.57 *	0.67 *		
KS4 VA 2005					0.58 *		0.28 *	0.26 *	0.50 *	0.57 *	
Absence 2005						0.60 *	-0.50 *	-0.36 *	-0.51 *	-0.46 *	-0.38 *

* statistically significant at 5% level

APPENDIX C ADDITIONAL RESULTS

Apdx Table A.6 Association between Performance Indicator and Position in E-maturity Distribution - Logistic Regression Results for Primary Schools

	Odds Ratio	P
Upwards Movers vs. Stayers		
Average Points 2002	1.08	0.718
Average Points 2005	0.74	0.230
Base	89	
Upward Movers vs. Downward Movers		
Average Points 2002	0.84	0.528
Average Points 2005	0.70	0.335
Base	71	

Note: Results after controlling for school characteristics.

Apdx Table A.7 Association between Performance Indicator and Position in E-maturity Distribution - Logistic Regression Results for Secondary Schools

	Odds Ratio	P
Upward Movers vs. Stayers		
KS3 Points 2002	0.40	0.010 **
KS3 Points 2005	1.86	0.040 **
% A*-C 2002	0.94	0.128
% A*-C 2005	1.01	0.632
% A*-G 2002	1.01	0.882
% A*-G 2005	0.96	0.547
% Authorised Absences 2002	1.62	0.020 **
% Authorised Absences 2005	0.77	0.220
Base	97	
Upward Movers versus Downward Movers		
KS3 Points 2002	0.67	0.235
KS3 Points 2005	1.20	0.603
% A*-C 2002	0.93	0.60 *
% A*-C 2005	1.03	0.405
% A*-G 2002	0.96	0.689
% A*-G 2005	1.08	0.424
% Authorised Absences 2002	1.54	0.124
% Authorised Absences 2005	0.53	0.045 **
Base	66	

Note: Results after controlling for school characteristics.
Separate regressions run for each indicator.
** statistically significant at 5% level
* statistically significant at 10% level