EXAMINING THE EFFECT OF PUPIL BACKGROUND ON PRIMARY AND SECONDARY PUPILS' ATTAINMENT: KEY FINDINGS FROM THE IMPROVING SCHOOL EFFECTIVENESS PROJECT

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SYNOPSIS

This paper describes some of the key findings of the Improving School Effectiveness Project (ISEP) study of Scottish primary and secondary schools, examining the impact of pupil background characteristics on pupils' cognitive attainments, and progress in these attainments over a two-year period. The project sought to integrate the two research traditions of school effectiveness and school improvement and involved a combination of quantitative and qualitative methods. By drawing on both school effectiveness methods and the legacy of sociological and educational studies we have explored the impact of structural influences, such as socio-economic status. We believe the ISEP research provides a rich source of evidence which can help to illuminate the current equity debate. Our findings illustrate both the strength of background influences, but also the importance of schools.

INTRODUCTION

The overall results of the ISEP study are summarised in Improving School Effectiveness (MacBeath and Mortimore, 2001). Thomas *et al* (2001) provide a brief account of the main results of the analyses of pupil progress and the development of a Value Added framework for the study of school effectiveness. Our paper focuses in more depth on the research design and the analysis of differences in pupil attainment and progress in this major longitudinal study. We pay particular attention to the impact of pupil background and the contextualisation of results (Sammons *et al*, 1998). The ISEP database allows us to examine in detail relationships between various pupil background factors and pupils' attainments in Reading and Mathematics at two separate time points (1995 and 1997) for both primary and secondary age cohorts. We can also measure the amount of pupil progress over this two-year period. The nature of background influences remains a topic of considerable importance for those concerned with promoting equity in education (Brown & Riddell, 1992; Smees & Sammons, 1998). It is also of relevance given the priority attached by the Government's Autumn Package (DfES, 2001) which uses benchmarks and target setting for schools and LEAs in England as part of its drive to raise standards of literacy and numeracy. In Scotland schools are expected to carry out school self evaluation activities, using publiactions such as 'How good is our school?: Self-evaluation using Performance Indicators' (SOIED, 1996) at the primary level, and 'Using Examination Results in School Self-Evaluation: Relative Ratings and National Comparison Factors' (SOIED, 1991) at the secondary level.

Previous sociological and educational research conducted over several decades has revealed the existence of statistically significant links between pupils' background characteristics and their educational attainment. Earlier studies emphasised the impact of factors such as IQ, low family income, social class and unemployment, poor housing and parents' educational levels, which led to the development of concepts such as the 'cycle of disadvantage'. The impact of other factors such as race, fluency in English and English as a Second Language (E2L) status, gender and age (within a year group)

received more attention during the 1970s and 1980s (for reviews see Rutter & Madge, 1976; Essen & Wedge, 1982; Mortimore & Blackstone, 1982; Mortimore *et al*, 1988; Patterson, 1991; Brown & Riddell, 1992; Sammons *et al*, 1994).

More recent longitudinal research has attempted to explore the influence of such background factors over the long term using multilevel modelling techniques. This has emphasised the need to examine the impact of socio-economic disadvantage, gender, race and fluency in English simultaneously so that, for example, ethnic differences are not confounded with those related to class and income. Such research has shown that, while the patterns of differences in relation to socio-economic factors are fairly stable, those related to ethnicity are more varied and may change over time (Sammons, 1995). Also, the impact of background factors has been shown to be more marked for language-based educational outcomes than for subjects such as mathematics (Brandsma & Knuver, 1989; Mortimore *et al*, 1988; Sammons, 1995; Thomas *et al,* 1997).

If comparisons are to be made between schools on the basis of their pupils' results in national assessments or national examinations, it is vital that comparisons seek to compare 'like with like'. To do this we need to take into account the fact that schools in different areas often serve very different kinds of intakes, and thus face different educational challenges. By exploring the relationships between various personal and family characteristics and pupils' attainment levels we can establish the strength of links between specific characteristics of schools' intakes and their results. There are important implications for promoting equity in education depending upon the interpretation adopted. For the analyses our objectives were to investigate the relationships between:

- pupil background characteristics and their reading and mathematics *attainment* for two age cohorts assessed in P4 and S2 (1995) and again at P6 and S4 (1997);
- pupil background characteristics and their *progress* in reading and mathematics over this two year period; and
- pupil attendance, attainment and progress.

We also wanted to:

- examine whether there were any differences between our representative sample of 80 primary and secondary schools in pupils' reading and mathematics attainment and progress after control for intake differences, in terms of pupil i) background factors and ii) prior attainment.

THE PROJECT SAMPLE AND DATA COLLECTION

In all, 80 schools (44 primary and 36 secondary) were included in the ISEP sample, and collected attainment data was collected for around 7000 pupils. Complete pupil groups in these schools were recruited for this aspect of the study. The focus was on the P4 (age 8/9 years) and S2 (age 13/14 years) cohorts in 1995. The progress of these groups was then tracked over two years to P6 and S4 respectively. Before the 1996 reorganisation of local government in Scotland the sample were found to be distributed across all but three local education authorities. The schools represent a wide range on a number of dimensions including attainment profile, size of roll, denomination, situation (rural/urban) and socio-economic characteristics of the catchment area.

For reasons of curricular validity and overall reliability, assessments from the Scottish Assessment of Achievement Programme (AAP) were selected for English language (Napuk *et al,* 1992) and for Mathematics (Robertson *et al*, 1993). These are

consistent with the curricular targets of the 5–14 programme and AAP surveys also provide national norms for the Scottish context. The AAP reading assessments were chosen because they relate to the cross-curricular skill of *reading for information*. The mathematics assessments covered both basic *numerical and mathematical processes and applications* of these in problem solving contexts (for details of the piloting of these assessments for ISEP see Smees, 1996). The range of assessments was increased by the addition of a widely used nationally standardised test of reading - the Suffolk Reading Scale (NFER-Nelson). Previous research has pointed to the importance of using assessments, which relate to the curriculum used by schools and the aims of teaching if the impact of schools is to be adequately measured (Madaus *et al*, 1979)

A variety of individual pupil background data was obtained from project schools. At the pupil level, data were collected on the following ten factors; gender, age in months, ethnicity, English as a second language (E2L), entitlement to free school meals (FSM), nursery education, number of terms in current school, number of previous schools, whether pupil receives learning support and whether pupil has a Record of Need (Appendix 1 gives details of the sample). A measure of attendance (% of sessions in the 1994/5 school year attended) was also collected for each pupil. This factor is not in itself an intake characteristic, but can be regarded as an educational outcome in its own right and susceptible to school influences. It can also be viewed as a process variable which is likely to have an impact on levels of pupil attainment, as has been demonstrated in other studies (see, for example, Audit Unit, 1995; Malcolm, Thorpe & Lowden, 1996).

In addition, some aggregate data concerning the composition of each school's pupil intake was also collected. This included:

% of pupils with a Record of Need

% of pupils for whom English is a second language

% of pupils eligible for free school meals.

These measures can be seen as further contextual indicators of the overall composition of the school's intake. Previous research in Scotland (Willms, 1986) has suggested that such contextual factors may have an impact on pupil attainment. In other words, over and above the influence of an individual pupils' own background characteristics, the composition of the intake to his or her school can also influence a pupil's results (see Sammons, Mortimore & Thomas, 1996 for a review of this issue).

METHODS

In order to identify and separate the influences of pupil background characteristics and school attended on pupil attainment it is necessary to use multilevel modelling techniques (Paterson & Goldstein, 1991; Goldstein, 1995). These provide the most reliable estimates of the net influence of individual factors. Thus, for example, the impact of gender can be identified (estimated statistically) while simultaneously controlling for the influence of other factors, such as a pupil's age or socio-economic status etc. Such methods also allow the total variance between pupils in terms of achievement in a given outcome measure to be split between differences between individual pupils (pupil level) and school attended (school level). This is crucially important because even in a comprehensive system, pupils are not randomly allocated to schools, which often differ markedly in terms of the characteristics of their intakes. One of the most important contextual factors in which schools' intakes can vary is in terms of the proportion of pupils from socio-economically disadvantaged backgrounds. The importance of this factor has been recognised officially since 1997 in the use of the %FSM measure in the process of school benchmarking and

target setting in England and Scotland, although it has also been questioned for its reliability (Croxford, 2000).

Two main types of multilevel models were adopted, contextualised and value-added:

- Contextualised - These models are cross-sectional, which means they examine variation in attainment at a given point in time for the two ISEP pupil cohorts (either 1995 or 1997). They enable the net impact of background characteristics such as gender on attainment in reading or mathematics to be estimated. In this way we can establish whether differences in attainment related to background increased or decreased in absolute terms over the two-year period (1995–1997). This is an important issue with both practical and policy implications. If differences related to pupil background increase this would suggest schools may have little power to reduce inequities in educational achievement. If they reduce, however, this may point to the ability of schools to help promote greater equity in educational outcomes.
- Value Added - These models are longitudinal, which means they examine pupil progress. In the ISEP study we measured progress over two school years by controlling for the pupil's prior reading or mathematics attainment, using the 1995 measures as baselines and the 1997 measures as outcomes. In this way it is possible to establish whether some pupil groups, for example girls or boys, made relatively more or less progress than others over these two years. Value added models also enabled us to establish whether there are systematic differences between schools in their pupils' outcomes, after controlling for differences in intake (both background factors and prior attainment). In particular, we seek to find out how much of the variance in pupil outcomes not accounted for by intake (unexplained in the model), lies at the school and the pupil levels.

RESULTS

Correlations between pupils' scores in the three measures of reading and mathematics at different time points are not perfect. For girls at P4 we find that AAP reading and mathematics results are more closely related (r=0.70) than is the case for boys (r=0.64, Appendix 2). A similar pattern is evident at S2. Descriptive statistics for the sample are given in Appendix 3.

Multilevel analyses were carried out to study the impact of pupil background on attainment and progress and also the impact of the school. The key findings were:

(i) The impact of background factors

- Each variable was tested individually and in combination. Where data were missing for large numbers of pupils or schools (eg whether pupils had experience of nursery education) or where the number of pupils in particular groups were very small (eg ethnicity) variables were not included in the final models to maximise sample size. At the secondary level, due to the large reduction in sample size (670 cases) resulting from missing data which would reduce the number of schools included in the analysis from 36 to 32, the main analysis of background factors does not include Learning Support (LS) and Record of Need (RON). As a result the main models we report for the secondary sample are not identical to those shown for primary schools. However, we also describe the results of the multilevel analysis of the reduced sample to illustrate the impact of these two important measures of pupils' educational experiences for secondary pupils (see Table 6).

- *Special Educational Needs* As would be anticipated, pupils identified as having learning difficulties and receiving learning support attained less highly in both reading and mathematics at both P4 and P6. Having a RON, however, was statistically significant only for mathematics attainment. For secondary pupils both factors were highly relevant, although due to missing data for some schools these analyses were based on a reduced sample. At the secondary level such pupils made less progress than others across S2 to S4.

These results, although predictable, have important implications for target setting and comparisons of schools' performance. At present, schools vary in the way they define the need for learning support and in the nature of any provision made. For pupils this means that provision can be a 'geographical lottery' (see Marsh, 1998 for discussion of this issue in two English LEAs). Further work on this area is needed to explore whether specific approaches to supporting pupils with particular learning needs can help to overcome such difficulties and reduce the likelihood that such pupils will continue to fall behind. At the pupil level, special consideration to the setting of appropriate targets is likely to be needed. Schools that receive larger number of pupils with such needs are at a disadvantage if this factor is ignored in comparisons of performance.

For institutions with large numbers of pupils with special needs, overall school targets may require similar modification. Special attention to improving the ways schools address the needs of the lowest achieving pupils will be needed if the problem of 'the trailing edge' phenomenon is to be reduced and social inclusion promoted. This group has been identified as requiring particular attention in the Scottish New Community Schools pilot programme (see Sammons *et al*, 2000). The allocation of extra resources for provision for such pupils could be an important way to assist schools with a high proportion of children with low attainment at entry to school. By focussing on low attainment at entry the danger of rewarding poor performing schools would be removed, and the tendency for some over-subscribed schools to be socially selective could be reduced, thus helping to promote more academically balanced intakes in line with the aims of comprehensive education.

- *Age* Older pupils within a year group attain more highly in reading and mathematics at both P4 and P6. This is also the case for the secondary sample at both S2 and again at S4. Most teachers' assessments of pupils' class work is conducted on a day to day basis and does not take account of pupil age. The implications of the continuing impact of age differences within a year group are important, given the absence of age standardisation in teachers' assessments of most schoolwork completed by pupils. The possibility that both teachers' and pupils' expectations may be adversely affected for younger members of a class, the 'summer born phenomenon', through regular comparison of their work with that of older classmates that does not take account of age differences needs to be acknowledged. Raising teachers' awareness of the significance of age differences in attainment and their continuing impact even at secondary level may help teachers to identify the needs of all pupils more accurately.

Given the importance of teacher assessment (day to day and more formally), ways in which age adjustment can be incorporated to avoid penalising children who are young for their year require attention. The use of some age standardised assessment techniques may be important to ensure that teachers and pupils receive more accurate feedback about each pupil's performance *relative to their chronological peers*. Appropriate ways of acknowledging age differences, without lowering expectations, need to be developed. The implication of age effects continuing until age 16 when

pupils sit public examinations is a cause for particular concern, given the 'high stakes' nature of this form of assessment, and the large numbers of pupils affected.

- *Gender* We found that there were no statistically significant gender differences in pupil performance at P4 in literacy or mathematics for our ISEP sample. This is in contrast to research on national assessment results in England (Sammons & Smees, 1998) where gender differences have been found to be significant at the end of Key Stage 1 (age 7 years plus). Two years later, however, girls as a group were ahead in reading, whereas boys were ahead in mathematics. The appearance of gender differences in attainment for the same pupils at P6 indicates that, at the primary level, boys in the ISEP sample made more progress in mathematics and girls more progress in reading across the two years 1995 to 1997. The reasons underlying these differences in progress rates during the later years of primary education require further explanation. Out of school activities, parental and peer expectations may be relevant, as well as classroom activity.

It is notable that boys were not ahead at S2 for our secondary sample in mathematics but gender differences (in favour of girls) were found to be significant for reading. We know from our analysis of pupil progress that earlier reading performance is related to later achievement in school in other subjects. At the secondary level, however, S2 mathematics performance was found to be a better predictor of overall Standard Grade performance, although reading skills also remain important and statistically significant.

The ISEP data provide clear evidence that girls outperformed boys in overall performance at S4 in two measures: Best 7 grades and English. Girls were also marginally ahead in mathematics at Standard Grade, although the difference just failed to reach statistical significance with our sample. The value added analyses of progress from S2 to S4 also indicate that girls as a group made more progress than boys from S2 to S4 across this two-year period.

- *Socio-economic disadvantage* The greater impact of background factors on pupil performance in reading, particularly at the primary level, has important messages for the league table debate and publication of schools' raw national assessment results. Brown, Duffield & Riddell (1995) have drawn attention to the continuing need to consider socio-economic influences in interpreting school performance data based on their case studies of effective and less effective schools. Our study confirms that pupils from socio-economically disadvantaged homes tend to attain poorer results than other pupils (using FSM as an indicator). We found that reading performance is more closely related to FSM status than mathematics results for both primary and secondary pupils.

The ISEP research also demonstrates that the composition of a school's intake, in terms of the percentage of pupils eligible for free school meals, has an influence on individual pupils' results, over and above their own characteristics. Performance levels tend to be depressed in schools where there are high concentrations of disadvantaged pupils in the intake. It appears to be harder for such schools to raise standards. Again this is relevant to the discussion of to what extent schools receive a balanced (ie comprehensive) intake. When account was taken of pupil intake characteristics the contextualised analysis shows that significant school differences in performance remain, though these are much smaller than raw differences, especially for reading assessments. We also find from the multilevel analysis that the school level variation is particularly affected by the inclusion of background data about pupil intakes. This is an important message for those concerned with developing frameworks to monitor and report on school performance.

Although evidence of the links between socio-economic disadvantage and pupil attainment has accumulated over the years the interpretation of this remains controversial. The ISEP data provides powerful research evidence of the links between low income and low attainment and especially worrying lower rates of progress in the Scottish context. Whilst not an excuse to lower expectations for such pupils, this evidence supports the view that schools which serve such communities require some extra help to meet the challenge of raising standards (Mortimore & Whitty, 1997). Targeting such schools (ie via the creation of Education Action Zones in England, or initiatives such as New Community Schools in Scotland) may help provide resources to support some of these schools. Where secondary schools receive very high numbers of pupils with low attainments at intake, particular strategies and careful monitoring to focus on raising basic skills (reading and numeracy) may need to be given priority to ensure that such pupils can access the wider secondary curriculum (Taggart & Sammons, 1999).

The ISEP research was conducted prior to the implementation of national literacy and numeracy hours in England and it remains to be seen whether such system-wide curriculum innovations can help to reduce the 'achievement gap' between the more and less disadvantaged groups of pupils, although early evidence suggests primary schools in disadvantaged areas have improved most rapidly in England (OFSTED, 2001; Earl *et al*, 2001).

(ii) School Differences in Reading and Mathematics Attainments in 1995 and 1997 (Contextualised model)

Multilevel analysis separated the percentage of overall variance in pupils' reading and maths results attributable to schools from that attributable to differences between pupils before and after control for differences in pupil intakes. By doing this we gain an idea of the relative strength of pupil background as an influence on attainment, and also answer the question: what impact are schools having on the attainment of pupils? Table 1 summarises the main findings for primary pupils.

For the primary sample in 1995 it can be seen that, when no control is made for the impact of pupil background factors, a noticeably higher proportion of the variation in the AAP reading measure is found to lie between schools (18.4%). Controlling for pupil background factors accounted for a much higher proportion of the school level variance in the P4 sample's reading than mathematics scores (70% for both reading measures but only 30% for mathematics). We can conclude that differences in intake characteristics (particularly socio-economic status) have a much stronger impact on schools' results for reading, and thus that comparison of schools' raw (unadjusted for intake) results are especially misleading for this outcome. After controlling for pupil background factors we find that around a third of the total variance in pupils' reading scores was accounted for but less than a quarter for mathematics, again demonstrating the need to control for background factors in any comparisons of pupil attainment at the school level. In all, around five per cent of the total variance in reading measures remained attributable to school, but somewhat more for mathematics (7.5%) in 1995.

These findings suggest that differences between the ISEP primary schools in pupils' attainment in both reading and mathematics seem to increase over the two years covered by the project. This conclusion is in line with that reported by Sammons *et al*'s 1993 follow up study of inner London primary school pupils' but the trend is more pronounced, possibly a reflection of the use of curriculum relevant assessments in the ISEP research.

Another notable finding is that the percentage of total variance accounted for by pupil background factors was reduced for all outcomes by 1997 in comparison with 1995. This indicates that a child's background plays a relatively less important role

Table 1: Percentage of variance in primary pupils' reading and mathematics attainment attributable to school with and without intake controls

n of schools = 44	**AAP Reading**		**AAP Mathematics**	
	P4 1995 Pupil n n=1358	P6 1997 n=1096	P4 1995 Pupil n n=1350	P6 1997 n=1102
Model 1 No control for pupil background factors	18.4	11.9	10.7	21.5
Model 2 Controlling for pupil background factors	5.5	7.5	7.5	18.1
% total variance accounted for controlling for pupil background factors (Model 2)	32.1	17.2	23.6	19.9
% school level variance accounted for controlling for pupil background factors (Model 2)	70.3	37.0	29.7	15.6
Intra-school correlation	0.079	0.091	0.098	0.227

in accounting for differences in attainment in the basic skills for older primary pupils suggesting that the belief that a school can do little to counteract a disadvantaged background may be misplaced. We have shown that socio-economic disadvantage is an important 'risk factor' and needs to be addressed, but for individual pupils, results are by no means pre-determined and the same set of background factors account for less of the variation between pupils in their cognitive attainments at P6 than it did at P4.

Table 2 shows the equivalent contextualised multilevel results for the ISEP secondary cohort's performance at S2 and S4. We found that information about pupils' background characteristics shows weaker relationships with attainment measures than for the primary school sample. However, the absence of two factors (LS and RON) in these models has an impact on the results and their interpretation. In all, only 7.5 per cent of the total variance in pupils' total AAP mathematics scores and 12.4 per cent for AAP reading scores was accounted for by the combination of background data available (pupil age, gender, eligibility for free school meals and the % pupils in the age group eligible for free meals, and years in school). As with the primary analysis, background factors accounted for a substantial proportion of the school level variance in these outcome measures (ranging from just under 38% for AAP mathematics, to 59% for AAP reading). This again shows that intake differences are important when we consider school differences in pupils' attainments.

Our ISEP results thus suggest that school differences in pupil attainment in the basic skills are more marked at the primary than the secondary level again pointing to the importance of this phase in pupils' school careers in determining literacy and numeracy performance. They also suggest that pupils' background becomes relatively less important in accounting for variations between pupils in their attainments at the secondary level.

It can be seen that, controlling for the impact of background factors accounts for a greater percentage of the total variance in English than in mathematics. The intra school correlations for the three Standard grade results are all somewhat higher than

those found in the reading and mathematics analysis at S2 (0.100 English, 0.072 mathematics, 0.089 overall performance). This suggests that secondary schools vary more in their Standard Grade examination results than in pupils' attainments in basic skills.

Table 2: Contextualised Multilevel Level Model: Percentage of variance in S2 pupils' reading and mathematics performance attributable to school with and without intake controls

n of schools = 36/33	**Reading/English**		**Mathematics**		**Best 7**	
	S2 1995 Pupil n	S4 1997	S2 1995 Pupil n	S4 1997	S2 1995 Pupil n	S4 1997
	n=5123* n=4343**	n=4406* n=3730**	n=4918* n=4156**	n=4406* n=3730**	N/A N/A	n=4406* n=3730**
Model 1 (non reduced sample) No control for pupil background factors	12.0	14.4	8.4	12.6	N/A	14.8
Model 1 (reduced sample) No control for pupil background factors	13.2	13.6	9.1	12.3	N/A	14.0
Model 2 Controlling for pupil background factors, excluding LS and RON	4.9	8.5	5.3	6.4	N/A	7.6
Model 3 Controlling for pupil background factors, including LS and RON	6.3	7.9	8.5	8.9	N/A	8.9
% total variance accounted for by controlling for pupil background factors (Model 2)	12.4	15.3	7.5	11.1	N/A	14.9
% school level variance accounted for by controlling for pupil background factors (Model 2)	59.2	41.5	37.6	49.3	N/A	48.7
% total variance accounted for by controlling for pupil background factors (Model 3)	22.4	23.1	17.5	13.1	N/A	21.9
% school level variance accounted for by controlling for pupil background factors (Model 3)	52.4	41.8	7.1	19.9	N/A	36.5
Intra-school correlation (Model 2)	0.056	0.100	0.057	0.072	N/A	0.089
Intra-school correlation (Model 3)	0.081	0.103	0.102	0.108	N/A	0.114

* Model 2 ** Model 3 N/A Not applicable

Pupils' educational experiences

Further analyses were conducted after excluding cases with missing data to examine the impact of the two measures relating to Learning Support (LS) and Record of Need (RON) as identified in S2. For S2 these analyses were based on 4343 pupils and 32 schools. As with the primary analysis, the results indicated that both these factors had a significant negative relationship with the two measures of reading and also mathematics. Both LS and RON, of course, provide crude indicators of prior attainment and learning and/or behavioural difficulties. In all 16.9% S2 pupils had LS and 2.1% a RON. The contextualised results for 1997 Standard Grade results were based on 3730 cases and 32 schools and demonstrated that, controlling for other background factors, pupils categorised as receiving Learning Support in 1995 obtained statistically significantly poorer results in English, mathematics and overall (best 7) Standard Grade performance in 1997. Those with a Record of Need likewise obtained significantly poorer Standard Grade results in these three measures.

(iii) Pupils' Progress P4 to P6 (Value added model)

Value added models were used to explore pupil progress. Details about pupils' performance in P4 and two years later in P6 were matched for around 1100 pupils and 4406 pupils matched from S2 to S4. Table 3 shows the correlations between pupils' scores in reading and mathematics in 1995 and 1997 for the primary cohort and reading, mathematics and best 7 for the secondary cohort. Thomas *et al* (2001) describe the use of Value Added models to analyse school effectiveness.

Table 3: Correlations between pupils' baseline and outcome scores in assessments of reading, mathematics and overall performance

		Outcome		
		Reading/ English	**Mathematics**	**Overall performance (Best 7)**
Baseline	AAP Reading	0.58*/0.62**	0.59*/0.62**	0.66**
	AAP Mathematics	0.53*/0.61**	0.74*/0.80**	0.73**

* Primary correlations ** Secondary correlations

Our value added analyses of pupil progress from 1995-97 for the primary sample indicate that, as might be expected, the prior attainment measures account for a substantial proportion of the total variation in pupils' scores in P6 (see Tables 4 and 5). As a whole, pupils who scored highly in 1995 tended to do well in 1997 also. Although the primary 1995 AAP mathematics score was the best predictor of later mathematics achievement, the reading measures were also significantly associated with later mathematics results at P6. Controlling for prior attainment (1995) accounted for more total variation in the three outcome measures in 1997 and less school level variation than the contextualised model at the primary level. The reduction in total variance (controlling for prior attainment) was higher for the AAP mathematics assessment (57%) than for the AAP reading measure (42%). For the secondary cohort the reduction in total variance (controlling for prior attainment) was also higher for the AAP mathematics assessment (66%) than for the AAP reading measure (54%).

Our results demonstrate that, controlling for prior attainment at P4, girls make more progress in reading than boys. The free school meals measure just failed to reach significance with this sample, however. For mathematics, by contrast, girls made significantly less progress, as had children identified as in need of learning support earlier in their primary schooling. The results of the value added analysis of progress demonstrate the existence of much greater variation between primary schools in pupils' mathematics progress (intra-school correlation 0.326) than in reading. We also find that the intra-school correlations are higher in the value added than in the contextualised models we described earlier.

Table 4: Final Value Added Multilevel Model: Pupil attainment at P6 (1997)

n of schools = 44 Fixed effects	AAP Reading Pupil n n=1096	AAP Mathematics Pupil n n=1102
Age	ns	ns
FSM	ns	ns
Girls	+*	–*
Less than 4 years in current school	ns	ns
Learning support	ns	–*
Record of Need	ns	ns
%FSM	ns	ns
Suffolk 1995	+*	+*
Reading 1995	+*	+*
Mathematics 1995	+*	+*
% total variance accounted for controlling for prior attainment and background	42.1	56.7
% school level variance accounted for controlling for prior attainment and background	41.0	34.4
Intra-School correlation	0.122	0.326

* $p<0.05$ ns not significant

Our value added analysis of secondary pupils' progress from 1995-97 shows that the two prior attainment measures (AAP mathematics and AAP reading) account for a substantial proportion of the total variation in pupils' Standard Grade results at S4, as we would expect given the correlations shown in Table 3. When we take account of pupils' prior attainment we find that we explain (statistically) a much greater percentage of the total variance in pupils' Standard Grade results in 1997 than when we only include details about pupils' background (54% for English but rather more for mathematics at 66% and overall performance 64%). This emphasises that information about a pupils' prior attainments is a much better guide to teachers in terms of target setting than information about home circumstances.

Table 5: Final Value Added Multilevel Model: Pupils' Standard Grade attainment at S4 (1997)

n of schools = 36 Fixed effects	**English** Pupil n n=4406	**Mathematics** Pupil n n=4406	**Overall Performance (Best 7)** Pupil n n=4406
AAP Mathematics 1995	* +	* +	* +
AAP Reading 1995	* +	* +	* +
Gender (girls)	* +	ns	* +
FSM	* –	ns	ns
Age in months	ns	ns	ns
[+]Too young	ns	ns	ns
[+]Too old	ns	ns	* +
%FSM	* –	* –	* –
% total variance accounted for controlling for prior attainment and background	54.3	65.9	64.0
% school level variance accounted for controlling for prior attainment and background	77.6	86.5	85.4
Intra-School correlation	0.0708	0.0609	0.0602

+ Measures of whether pupils were chronologically too young or old for their year-group (ie outside the 12 month range).

* $p<0.05$

ns not significant

We found that gender and FSM all show a significant relationship with Standard Grade performance in English and the overall performance measure. Moreover, in contrast to the primary results the contextualised measure, percentage of pupils eligible for free school meals was also statistically significant. In interpreting these results, it should be noted that the larger sample size for the secondary analysis influences the calculation of statistical significance (with a smaller sample, larger effects are needed before statistical significance can be established). It may also be that the degree of disadvantage of a school's intake has an impact upon secondary school culture that is not evident at the primary phase. Again, the importance of pupil composition has implications for policies on selection. Schools with concentrations of disadvantaged pupils have a greater risk of all pupils performance being depressed.

It was also found that those in receipt of LS in S2 obtained poorer results (ie made less progress from S2 to S4). However, this was not the case for RON. Again, it should be remembered that schools vary in the criteria they use to determine eligibility for Learning Support. Nonetheless, this factor was clearly related to attainment and

Table 6: Final Value Added Multilevel Model:
Pupils' Standard Grade attainment at S4 (1997), including LS and RON

n of schools = 33 Fixed effects	**English** Pupil n n=3730	**Mathematics** Pupil n n=3730	**Overall Performance** Pupil n n=3730
AAP Mathematics 1995	* +	* +	* +
AAP Reading 1995	* +	* +	* +
Gender (girls)	* +	ns	* +
FSM	* –	ns	ns
Age in months	ns	ns	ns
[+]Too young	ns	ns	ns
[+]Too old	ns	ns	* +
Learning Support	* –	* –	* –
Record of Need	ns	ns	ns
%FSM	* –	* –	* –
% total variance accounted for controlling for prior attainment and background	66.1	55.6	64.4
% school level variance accounted for controlling for prior attainment and background	84.3	80.9	87.3
Intra-School correlation	0.063	0.053	0.050

+ Measures of whether pupils were chronologically too young or old for their year-group (ie outside the 12 month range).

* $p<0.05$

ns not significant

progress at secondary school for the ISEP sample. The results demonstrate that those in receipt of LS continue to be at an educational disadvantage in terms of attainment in public examinations. It cannot be established, however, whether such pupils would have attained even lower results without such support, or whether identification tends to 'label' pupils and reduce expectations.

The value added secondary results demonstrate the existence of statistically significant school effects, although the intra school correlations are considerably lower than those found for the primary sample (ranging from 0.060 to 0.071). The equivalent figures for the primary sample are given in Table 4 and are markedly larger. In contrast to the primary sample there was no evidence that at the secondary level schools' effects varied more for mathematics than for English.

These results for the ISEP secondary pupil sample tend to support the contention that primary schools can vary in their effectiveness to a greater degree than do secondary schools.

School inspection has an important and controversial role to play in current systems of educational accountability and in shaping the perceptions of schools held by professionals and the media in Scotland. The Audit Unit has shown considerable interest in the development of value added indicators (SOED, 1992; Gray, 1993), while in England the Autumn Package now includes a simplified form of Value Added analysis. The ISEP research demonstrates that the availability of contextualised and value added information which seek to take account of the impact of intake through the use of prior attainment and background factors, can provide better performance data about schools. Such measures can assist schools in evaluating their effectiveness in promoting pupil progress as well as helping to inform those concerned with monitoring standards in schools as part of the process of inspection (Elliot *et al,* 1998; Smees & Thomas, 1999).

The greater impact of primary schools on attainment and progress in mathematics than in reading reported here is in line with earlier studies (eg Brandsma & Knuver, 1989; Sammons *et al*, 1993; Sammons & Smees, 1997) but especially striking with the ISEP primary sample. Our results also suggest that school level variations are more marked for primary than secondary age groups, which tends to support the view that this phase of education is particularly important in determining pupils' long term educational outcomes.

Powerful evidence of the links between pupils' background characteristics and both attainment and progress has been provided by our ISEP results. This supports and extends earlier research. While the findings are not surprising, in combination they suggest that success in current attempts to raise literacy and numeracy standards will be difficult to achieve unless the performance of specific groups is carefully targeted and monitored. Raising the attainments of boys in English (but also of girls in mathematics) and pupils from low income families will be essential for this task. Particular attention to ways in which the needs of pupils requiring learning support can best be met may also be necessary, especially given the policy of greater integration into mainstream.

- Age differences within a year group affect pupil attainment at both primary and secondary level including at Standard Grade (S4). Those young for their year perform significantly less well than others at all stages. This has implications for the use of different forms of assessment (eg teacher assessment) which is not age standardised.

- The impact of gender varies for the primary and secondary pupil samples. No significant gender differences in reading and mathematics were evident at P4, but by P6 boys as a group were ahead in mathematics and girls in reading. Girls had made less progress in mathematics but more in reading across these two years. At the secondary level, girls as a group were ahead in reading at S2. By S4 at Standard Grade, girls significantly outperformed boys in terms of English and overall performance (best 7 grades) and differences in mathematics in favour of girls just failed to reach statistical significance.

The differences in gender effects on attainment and progress between primary and secondary samples are of relevance to practitioners and policy-makers. Ways of raising secondary boys' performance in particular need to be addressed.

- Socio-economic disadvantage (as measured by eligibility for free school meals) shows a significant relationship with attainment at both P4 and P6. Those pupils eligible for free school meals attained poorer results than others, especially in reading.

At secondary level a similar pattern was identified in reading and mathematics at S2 and in Standard Grade results at S4. The value added analyses also showed that pupils eligible for free school meals also made less progress from S2 to S4. In addition, a compositional effect related to the percentage of pupils eligible for free meals in a school was also found. In schools where there were higher proportions of disadvantaged pupils from low income families, results for all pupils tended to be depressed.

These findings have important implications for policy developments concerning the use of raw league tables of schools' results that do not take account of intake differences. The ISEP results indicate that any value added approach needs to incorporate such data *in addition* to prior attainment measures. The results are also relevant to target setting and benchmarking and point to the need to provide additional resources in schools serving such communities to help raise standards for these groups. We can conclude that schools with a balanced (ie more comprehensive intake) are better placed to raise the attainment of disadvantaged groups.

- Two measures of pupils' learning experiences show strong relationships with attainment - those in receipt of Learning Support and those with a RON. Schools vary in the criteria used to decide which children receive learning support. Nonetheless, these factors are associated with lower attainment and, for the secondary sample, poorer progress. Adopting clear and agreed criteria to identify those requiring Learning Support and to monitor the attainment and progress of such children may be one way schools can help to raise standards for those with special needs, and help to reduce the inequities of the geographical lottery concerning the way needs are identified and resourced.

- The results revealed evidence that school effects vary more at the primary than the secondary level, pointing to the importance of this phase of schooling in determining pupils' long term achievement, especially in basic skills. School differences in relative progress in mathematics from P4 to P6 were especially marked. The greater importance of background factors as influences on reading than on mathematics, especially at the primary level, is relevant to the current debate about raising literacy and numeracy standards and the new policy of target setting for pupils, schools and Education Authorities. Collaborative initiatives which attempt to implement 'joined up policy' such as NCSs or EAZs or in areas of social disadvantage may help to improve standards for the most disadvantaged groups and to combat social exclusion (Scottish Office, 1998; Sammons *et al*, 2000; Tett *et al*, 2001). Ways of distributing resources to make such pupils more attractive to assist schools which cater for high properties of disadvantaged or vulnerable pupils requires further attention. (Sammons *et al,* 1997). The Scottish Executive's current emphasis on promoting social inclusion (SEED, 1999a&b) has led to a range of developments which seek to foster multi agency approaches.

Nonetheless, although we show that background factors have a significant impact, our results also reveal that this seems to be smaller with older age groups, thus early intervention is likely to be most beneficial, as pre-school studies suggest (Sylva *et al*, 1999). Moreover, the schools' influence is by no means negligible in comparison to that of a child's background. The ISEP results indicate that it is larger than the impact of either free school meals or gender in terms of accounting for differences between individual pupils in their attainments or progress. When we look at differences between schools rather than between individual pupils in order to measure effectiveness, we find intake has a more important role. This is an important

distinction that tends to be ignored in current debates. The ISEP research thus supports the argument that we must be very cautious to avoid lowering expectations for individual pupils because of their home circumstances, while acknowledging the need for school comparisons to take proper account of intake.

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APPENDIX 1

Characteristics of the sample at P4 and S4 (1995)

	P4 %	S4 %
Girls	47.8	49.1
FSM	26.6	17.4
LS	15.8	16.9
RON	1.7	2.1
E2L	0.8	0.8
Ethnic minority status	1.2	0.9
Less than 4 years in current school	17.5	31.6
More than one school	15.7	3.2

APPENDIX 2A

Correlations between P4 pupils' attainments in three baseline measures of reading and mathematics (1995)

		AAP Reading	AAP Mathematics	Suffolk Reading
All	**n**			
AAP Reading	1378	1.00	0.67	0.67
AAP Mathematics	1366		1.00	0.66
Suffolk Reading	1350			1.00
Girls				
AAP Reading	671	1.00	0.70	0.66
AAP Mathematics	711		1.00	0.69
Suffolk Reading	700			1.00
Boys				
AAP Reading	707	1.00	0.64	0.68
AAP Mathematics	650		1.00	0.63
Suffolk Reading	655			1.00

APPENDIX 2B

Correlations between S2 pupils' attainments in three baseline measures of reading and mathematics (1995)

		AAP Reading	AAP Mathematics	Suffolk Reading
All	**n**			
AAP Reading	5123	1.00	0.65	0.66
AAP Mathematics	4918		1.00	0.61
Suffolk Reading	4788			1.00
Girls				
AAP Reading	2501	1.00	0.69	0.69
AAP Mathematics	2392		1.00	0.66
Suffolk Reading	2323			1.00
Boys				
AAP Reading	2622	1.00	0.64	0.64
AAP Mathematics	2526		1.00	0.58
Suffolk Reading	2465			1.00

APPENDIX 3A

Raw Mean and Standard Deviation Scores for ISEP Pupil Sample Assessments (Primary) 1995 and 1997

		ALL		GIRLS		BOYS	
AAP Reading	1995 (1378)	55.2	(21.5)	55.6	(21.2)	54.9	(21.9)
	1997 (1096)	54.9	(24.5)	57.4	(24.6)	52.6	(24.4)
AAP Maths	1995 (1366)	63.0	(20.3)	63.6	(19.9)	62.5	(20.7)
	1997 (1102)	61.1	(18.1)	61.5	(18.9)	60.5	(17.2)
Suffolk Reading	1995 (1350)	39.3	(10.9)	39.9	(9.7)	38.8	(11.9)
	1997 (1111)	44.6	(9.0)	44.5	(8.4)	44.7	(9.6)

RAW AND SD (pupil level)

APPENDIX 3B

Raw Mean and Standard Deviation Scores for ISEP Pupil Sample Assessments (Secondary) 1995 and 1997

	n	ALL		GIRLS		BOYS	
1995							
AAP Reading	5123	64.3	(21.0)	67.3	(20.0)	61.4	(22.0)
AAP Mathematics	4918	52.3	(22.9)	52.1	(22.2)	52.5	(23.6)
Suffolk Reading	4788	55.3	(9.33)	55.9	(8.56)	54.7	(10.0)
1997							
English Standard Grade	4406	4.02	(1.21)	4.28	(1.15)	3.77	(1.64)
Mathematics Standard Grade	4406	3.50	(1.64)	3.55	(1.63)	3.45	(1.64)
Overall Performance (Best 7) Standard Grade	4406	27.0	(9.53)	28.4	(9.35)	25.7	(9.7)