The Irish Journal of Education, 1976, x, 1, pp 41-50

SCHOOL AND CLASS DIFFERENCES IN PERFORMANCE ON THE LEAVING CERTIFICATE EXAMINATION*

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For a sample (N 32) of Irish boys' post-primary schools, variations in students' scores on four standardized measures and on 13 Leaving Certificate examinations were partitioned into between-school, between-class-within-school and within-class components. Significant proportions of between-school variance were associated with performance on four Leaving Certificate examinations. Significant proportions of between-class variance were associated with the four standardized measures and with all Leaving Certificate examinations. The findings are interpreted as providing strong prima facie evidence of the differential effectiveness of school factors, particularly ones associated with class units.

Judgements regarding school effectiveness in several studies have been based on estimations of the amount of variance in achievement that lies between schools (3, 7, 9). It is argued that if there is no variation in students' achievement in different schools, then prima facie evidence of the differential effectiveness of schools is lacking. In their large-scale study of the American school system, Coleman *et al* found relatively little variance in achievement between schools. For example, for twelfth grade northern whites, only 7.84% of total variance in verbal achievement scores was found to lie between schools (3, p. 296).

The study of Coleman *et al* is open to many criticisms. Two are particularly relevant to the present study. Firstly, it is doubtful if a measure of verbal achievement adequately reflects the objectives of most schools, there is, in fact, evidence that school effects are more readily demonstrated when more curriculum sensitive measures of school output are employed (2, 6). And

* This study was supported by funds from the Carnegie Corporation, New York and the Department of Education of the Irish government. Computer analysis was carried out at Memphis State University.

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secondly, the use of the school as the unit of analysis may obscure the differential use by students of facilities *within* a school For example, a school may possess a science or language laboratory or library, but some students, or indeed classes, may never use them Again some teachers may be better than others, the use of a school mean has the effect of treating all as of equal effectiveness Using the class, rather than the school, as the unit of analysis goes some way towards differentiating between students' experiences within schools In studies which have adopted this approach, the proportion of within-school variance which can be attributed to differences between classes has been found to be considerable (5, 8)

The present study proposes to use curriculum sensitive measures of school output and both the school and class as the unit of analysis to examine school effectiveness at the end of the post-primary cycle in Irish schools Performance on the Leaving Certificate examination over a range of subjects is used as a measure of school achievement together with performance on a number of standardized tests Firstly, we shall estimate between-school variance in achievement, in the tradition of Coleman *et al,* to examine the differential effectiveness of schools And secondly, we shall estimate the amount of variance that lies between classes to examine the differential effectiveness of classes Comparisons will be made between the amount of variance that lies between schools and the amount that lies between classes

METHOD

School measures

The main school measures were the Leaving Certificate examinations, which closely follow syllabi prescribed by the Department of Education and are taken by students at the end of their post-primary schooling In 1973, the year in which the present data were collected, there were 34 subjects which could be taken in the examination There were separate ordinary level and higher level courses and examinations for all but three of the subjects For the present study, data were obtained for the most popular subjects while also sampling the principal areas of study (languages, social sciences, physical sciences and mathematics) The subject areas chosen were English, Irish, Mathematics, History, Geography, French, Chemistry, Physics and Biology

Results of examinations are in the form of grades, each grade representing a percentage range of marks as follows A (85+), B (70 – 84), C (55 – 69), D (40 – 54), E (25 – 39), F (10 – 24), no grade (less than 10)

There were sufficient numbers taking the higher and ordinary level examinations in Mathematics, English and Irish to permit a separate analysis for the higher and ordinary level papers In analyses, the above marking system was employed for these subjects In order to have sufficient numbers for analysis on the remaining examinations it was necessary to develop a scaling method that would equate similar grades on the higher and ordinary papers so that they could be used together There is ample precedent in Ireland for scaling ordinary and higher level papers For example, for the purposes of admission to the university, a weighting scheme based on the highest examination grades is used For the present study, results for each examination (apart from the six mentioned above), using the mid-point of a range to represent a grade, were scaled against performance on an objective test and against over-all examination performance using the weighting scheme employed by the universities About half the regressions carried out in this way were satisfactory, in other cases, the regressions were such that they could not be used for scaling the grades on lower papers into the scale for higher ones * The satisfactory regressions provided the base from which scaled values were derived The values finally derived, and which were applied to all papers (except English, Irish and Mathematics) were as follows A on a higher paper = 92, B on a higher paper = 77, C on a higher paper = 62, A on an ordinary paper = 56, B on an ordinary paper = 49, D on a higher paper = 47, C on an ordinary paper = 41, D on an ordinary paper = 33, E on a higher paper = 30, E on an ordmary paper = 25, F on a higher paper = 17, F on an ordinary paper = 15, took the paper but no grade given = 5 on both papers

An over-all measure of Leaving Certificate achievement, which was the mean percentage score for a student's six highest scores on the examinations he took, was also included in analyses

* This happened, for example, when the means on the variable used to scale which corresponded to grades on higher papers were greater than all means corresponding to grades on the ordinary paper In this case, there was no overlap It also happened when students with a grade of C or D had higher means on the variable used to scale than students with grades of A or B (as happened in the case of history) A third reason was little variability in grades assigned Finally, some grades on some papers bore little relationship to the criterion measure, so that for each grade level, the means on the ability measure were nearly equal

Information on performance on the following standardized tests was also available the SRA Primary Mental Abilities Test, Form A4 (10), the Gates-MacGinitie Reading Test Survey F, Form 1 (4) and the Graded Arithmetic-Mathematics Test (11) An IQ measure was derived from the Primary Mental Abilities test and two measures were obtained from the reading tests one of vocabulary and one of comprehension

Sample

A representative sample of 38 second-level schools (27 secondary, 10 vocational and one comprehensive) in Ireland attended by boys and having senior cycles was selected Within schools, first year classes of the Leaving Certificate cycle were selected, in most cases these students had just done their Intermediate Certificate examination and were in their fourth year in post-primary school Where there were three or fewer classes at this level in a school, all were selected, where there were more than three class-groups, three representative classes were chosen Altogether 58 classes were selected The standardized tests were administered to the students towards the end of the school year

TABLE 1

NUMBERS OF SCHOOLS, CLASSES AND STUDENTS FOR WHICH DATA ARE AVAILABLE ON EACH SCHOOL MEASURE

SCHOOL MEASURE	NUMBERS PARTICIPATING		
	SCHOOLS	CLASSES	STUDENTS
PMA IQ	32	48	825
READING VOCAB	32	48	828
READING COMPREH	32	48	826
ARITH-MATH	32	49	866
LEAVING CERT (MEAN ACHIEV)	32	49	900
ENGLISH (HIGHER)	30	39	285
ENGLISH (ORDINARY)	32	49	614
IRISH (HIGHER)	22	30	205
IRISH (ORDINARY)	32	49	672
FRENCH (COMMON)	27	40	307
HISTORY (COMMON)	26	43	399
GEOGRAPHY (COMMON)	29	45	603
MATH (HIGHER)	21	29	129
MATH (ORDINARY)	32	49	722
PHYSICS (COMMON)	18	28	204
CHEMISTRY (COMMON)	19	30	274
BIOLOGY (COMMON)	19	32	238

The Leaving Certificate examination, the results of which are used in the present study, was taken by the students one year later By that time, some attrition from the original sample had taken place No public examination results were received from six schools, reducing the size of our sample to 32 Of the original 58 classes selected, examination results were obtained for 49 Of the original 1,253 students involved in the study, examination results were obtained for 900 The standardized test results of students for whom examination results were not obtained were excluded from the analyses reported in this paper

Because of differences in school size and because students sat for different sets of subjects in the public examinations, the number of classes for which we had test data varied from school to school and from examination to examination (Table 1)

Analysis of data

Analysis is based on the random effects analysis of variance model for an unbalanced nested design Each score is considered as being separable into a school component (difference between school mean and grand mean), a class-within-school component (difference between class mean and school mean) and an individual-within-class component (difference between individual score and class mean) This may be represented by the following equation

$$x_{IND} - \bar{x}_{GRAND} = (\bar{x}_{SCHOOL} - \bar{x}_{GRAND}) + (\bar{x}_{CLASS} - \bar{x}_{SCHOOL}) + (x_{IND} - \bar{x}_{CLASS})$$

The estimated variance for each component (and the relevant percentage) is based on the procedure described by Bock (1, p 434 ff) The variance components are defined as follows

$$\text{est } \sigma_w^2 = MS_w$$

$$\text{est } \sigma_c^2 = \frac{MS_c - \frac{N-n}{N} MS_w}{n}$$

$$\text{est } \sigma_s^2 = \frac{MS_s - \frac{C-c}{C} MS_c - \frac{N-nc}{NC} MS_w}{nc}$$

$$\text{est } \sigma_t^2 = \text{est. } \sigma_s^2 + \text{est } \sigma_c^2 + \text{est } \sigma_w^2$$

where

est σ^2_w = estimated within variance

est σ^2_c = estimated class variance in school

est σ^2_s = estimated school variance

est σ^2_t = total estimated variance

MS_w = mean square within

MS_c = mean square for classes within school

MS_s = mean square for schools

C = mean number of classes per school in population (total sample)

c = mean number of classes in school for that test

N = harmonic mean of number of students per class in population (complete sample)

n = harmonic mean of number of students per class for that test

RESULTS

The results of the partitioning of variance for each of 17 school measures are set out in Table 2

The significance of the between-school component of variance was calculated by dividing the school mean square by the class mean square Significant F ratios were found for four of the 17 variables, these four were Irish (higher), Physics (common), Chemistry (common) and Biology (common)

An estimate of the significance of the between-class component of variance is obtained by dividing the class mean square by the within mean square Here significant F ratios were associated with 14 of the 17 measures, the three non-significant F values were associated with English (ordinary), Irish (higher) and Mathematics (higher)

TABLE 2

PERCENTAGES OF VARIANCE LYING BETWEEN SCHOOLS, BETWEEN CLASSES AND BETWEEN INDIVIDUALS

SCHOOL MEASURE	BETWEEN SCHOOL	WITHIN SCHOOL	
		BETWEEN CLASS	WITHIN CLASS
PMA IQ	28 9	39 8	31 2
READING VOCAB	25 2	39 7	35 1
READING COMPREH	19 9	48 2	31 8
ARITH-MATH	27 8	49 9	22 3
LEAVING CERT (MEAN ACHIEV)	14 7	58 7	26 6
ENGLISH (HIGHER)	21 2	43 6	35 2
ENGLISH (ORDINARY)	27 3	26 5	46 1
IRISH (HIGHER)	73 3	7 7	19 0
IRISH (ORDINARY)	29 3	25 1	45 7
FRENCH (COMMON)	17 6	61 1	21 4
HISTORY (COMMON)	22 1	52 6	25 2
GEOGRAPHY (COMMON)	21 6	50 2	28 2
MATH (HIGHER)	44 7	28 6	26 7
MATH (ORDINARY)	33 6	37 2	29 2
PHYSICS (COMMON)	44 8	24 9	30 2
CHEMISTRY (COMMON)	43 9	34 7	21 3
BIOLOGY (COMMON)	49 7	36 4	13 9

DISCUSSION

Contrary to what popular belief might lead one to believe, there was little difference between schools on standardized measures of ability and English attainment Neither was variance between schools on the Leaving Certificate examinations significant, with the exception of a small number of subjects It is important to bear in mind that this finding applies only to schools which actually offered particular subjects and examinations All schools do not offer the same range of subjects For example, in our sample, only 21 out of 32 schools offered higher mathematics while only 18 offered physics (cf Table 1) Our analyses were inevitably confined to schools which presented students for a particular examination Obviously, there are differences between schools that offer a subject and ones that do not, which our analyses do not speak to Furthermore, one cannot say on the basis of our findings that choice of school in the first place may not be important or that differences in attainment may not exist at lower levels in post-primary schools Our findings only refer to those who survive to the Leaving Certificate level and one's chances of survival may, of course,

be a function of the school one attends Nevertheless, the lack of school differences in our findings is perhaps surprising

A notable exception to our findings of lack of between-school variance is found in the case of the Irish (higher) examination Here a remarkably large percentage (73%) of total variance is associated with school differences Thus, some schools are notably more successful than others in achieving high marks in Irish in the Leaving Certificate School factors also seem to play a part, though not to the same extent as in Irish, in achievement in the sciences (Physics, Chemistry and Biology)

The strongest effects in the present study are associated with classes rather than with schools For the standardized tests, between-class variance is always significant This may be taken as evidence for streaming within schools, selection within schools seems to be more striking than selection between schools at this level

For all but four of the public examination results, between-class variance is also significant Of the four exceptions, two (Irish and Physics), as we saw, were associated with large amounts of between-school variance In the case of four of the public examination results (mean achievement, French, History, Geography), more than 50% of total variance is associated with classes It will be noted that, while science subjects tend to exhibit high between-school variance, language/arts subjects by contrast tend to exhibit more between-class variance

Finally, the relatively small proportions of achievement variance which belong within classes may be noted They are always less than 50%, usually of the order of 20 to 30% of total variance This suggests that a good deal of variance in achievement is not attributable to individual differences between students but rather to factors associated with the school

In conclusion, our findings provide prima facie evidence of the effect of school factors, particularly ones associated with classes, in the Irish educational system The between-school variation which we found, most notably in the case of Irish, suggests that factors operate at the school level, rather than at the class level, to influence attainment These could be traditions, climates, expectations and presses which permeate a whole school or they could even be physical facilities (library, language laboratory) which are available to all students On the basis of our findings, however, it is more usual for critical factors, whatever they may be, to operate at the level of the class than at

the level of the school, since in the case of most subject areas, the proportion of variance which was associated with classes was greater than the proportion associated with schools

This finding on the possibility of class factors influencing achievement must be tempered by our evidence for between-class differences in ability Thus student characteristics, either independently of school influences or, more likely, in collusion with them, may be important contributors to between-class variance in public examinations With this qualification in mind and with some exceptions, we may say that the class a student is in is more important than the school he is in A striking exception to this as we saw was the case of Irish, where the school is the important factor, while in the case of Chemistry and Biology, both school and class are important correlates of achievement But for other subject areas – in particular, English, French, History, Geography, and over-all achievement on the Leaving Certificate – our findings point to the importance of factors operating within the classroom.

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