CHAPTER 7

Specialization and Age of Entry to School

Two separate aspects of school organization are examined in this chapter. The first concerns the relationship between countries of the number of subjects studied (specialization) in the pre-university year by the mathematics group (Population 3a) and the mean mathematics achievement score. The second concerns the relationship between countries of the 13-year-olds (Population 1a) and 13-year-old grade (Population 1b) mean mathematics scores and the age at which they entered school.

Specialization

In some educational systems, pre-university year students study only three or four subjects and have been doing so since the age of sixteen (England and Scotland) whereas in other countries all students are expected to continue studying nine or more subjects to the end of their secondary school career. The English position is based on the alleged virtues of study in depth. The Swedish position (9 subjects) may be based partly on the assumption that, given the rapidity of technological change, which means that many of the next generation will almost inevitably have to be occupationally retrained at least more than once in their working lives, it seems that a broader education is more appropriate for the academically gifted.

In those countries where specialization occurs, it often happens that students begin dropping subjects as early as 13 years of age (e.g. England—see Jackson, 1966) and by the age of 16, there is an evident bias (arts versus science subjects) in the cluster of subjects studied. Does specialization really lead to a greater knowledge of the subject studied? It is possible to examine this in the light of the IEA data—knowledge in this case being defined as the mean achievement scores on the IEA mathematics tests. In Population 3a, all students were studying mathematics in the pre-university year; in some educational systems, however, mathematics was studied in conjunction with only two other subjects, whereas in other systems, it was studied in conjunction with eight or more.

There has been a great deal of discussion about the values of specialization, but no research appears to have been carried out. This is perhaps not surprising, since within systems of education there has been a uniformity of practice. Furthermore, where a system has had students specializing in three or four subjects only, it has been the brighter students who have studied four or five subjects and who would therefore be likely to be higher scorers than those only studying two or three subjects. The IEA Study is the first large-scale international study of its kind, and therefore this is the first time that comparisons can be made of achievement between groups studying a limited number of subjects and those studying more.

In the School Questionnaire, a question was asked about the average number of subjects studied in each grade in the school. Unfortunately, the data obtained are limited in application, since in some countries different interpretations have been put on the word "subject" by different head teachers. Some have interpreted all "subjects" as including sport and drama, whereas others have included academic subjects only. However, the data given in the Case Study Questionnaire on the "number of subjects studied" would appear to be in order. Table 7.1 indicates the average number of subjects studied per country (according to the Case Study Questionnaire), the mean corrected mathematics score in each country, and the standard deviation and the number of students.

If the eight countries showing eight or more subjects studied are combined to form one group, and the three countries showing four or fewer subjects are combined to form a second group, then the mean scores of the two groups are found to be 31.1 and 24.8 respectively, giving a difference of 6.3, which is highly significant. Students from countries where 8 or more subjects (of which mathematics is one) are studied at the pre-university level perform better in mathematics than students from countries where only four or less subjects (of which mathematics is one) are studied. This is contrary to expectation.

There are, however, complications. The United States system is

Table 7.1. *Number of subjects studied and mean score by country.* (Population 3a)

Country	No. of subjects studied	Mean score	Standard deviation	Number of students
Belgium	9+	34.6	12.6	519
France	9+	33.4	10.8	222
Netherlands	9+	31.9	8.1	462
Japan	9+	31.4	14.7	818
Finland	9	25.3	9.6	369
Fed. Rep. of Germany	9	28.8	9.8	649
Sweden	9	27.3	11.9	776
Israel	8	36.4	8.6	146
Australia	6	21.6	7.5	1089
Scotland	4	25.5	10.5	1422
U.S.A.	4	13.8	12.6	1568
England	3	35.2	12.6	967

not as specialized as it would appear from the entry in the table, because although it may be the case that only four "solids" are studied in 12th grade, they may not be the same "solids" as in 11th grade (or perhaps only one or two are the same in both grades) and thus the actual number of subjects studied in the last two grades could range from four to seven or eight. If the United States is omitted from the specialist group, the average score of that group then becomes 30.4, which is not significantly different from the average of 31.1 of the first group.

Assuming the IEA mathematics tests to be fair tests of mathematical achievement of the various pre-university populations studied, it is surprising that students from specialization countries do not score significantly higher than students from non-specialization countries. It should be pointed out perhaps that some English mathematical educators have stated that they did not think that the IEA mathematics test extended the best students. Furthermore, in England, the syllabus in Applied Mathematics was covered only to a very small extent by the tests. Because of the wide range of scores between countries within each of the two groups, it would seem that there are obviously factors other than the number of subjects studied which account for the differences.

The average ages of the students in the eight countries (i.e. the first eight countries in Table 7.1) are, with one exception (Japan), over 18, while the average ages of the students in the four remaining countries are all under 18. Taking more subjects thus appears to be associated with a higher age, the assumption being that students must prolong their school education to be able to carry the extra load.

It is perhaps also of interest to note that in two of the three countries in which four or fewer subjects are studied there is a mandatory age of entry to school of five years. The question of differing degrees of retentivity has been dealt with in Chapter 5, but is also relevant in these comparisons. It is striking that the students in Israel and Belgium do not differ very much from English students in age, since Belgium has approximately the same degree of retentivity as England and the mean mathematics scores of each of these countries are close to each other, even though in England the average number of subjects studied is five less than in the other countries.

The conclusion that specialization, in the sense of restricting the number of subjects studied in the pre-university year, is not necessarily related to higher scores in mathematics, will probably be of interest to educational policy makers and planners in England, Scotland and Australia. However, it must be emphasised that this study of specialization is extremely limited because of the wide differences on several important independent variables which have not been held constant in this analysis. It is important that further work is carried out both nationally (cf. Pidgeon *et al.*, 1967) and internationally. Hopefully, with IEA continuing in six subject areas it will be possible to examine the effects on other subject areas when specialization takes place in a particular subject.

Age of Entry to School

In each country there are regulations specifying when "normal" children (i.e. excluding such children as spastics, extremely mentally retarded, etc.) should at the latest begin compulsory schooling. In some countries (e.g. Sweden and Germany) there is a single day in the school year on which all children within a year age range begin school. In others (e.g. Scotland and England) there are two or three possible days of entry. In most areas in England, for example, all

8 – 671266 *Postlethwaite*

children who will be five years of age between September and the end of December begin school on the first of September; those who will be five between January and the end of March begin on the first of January; and those who will be five between April and August begin in the middle of April.

As with most general regulations, there are exceptions. In certain countries children slightly younger than the mandatory age of entry may begin school if there are exceptional grounds. It is usually the local school authority which then decides whether or not the grounds are exceptional. In several European countries it is possible for children to start school before they reach the mandatory age, if they can prove that they are "mature" enough for school. The judgement of this maturity has, up to the present time, involved physical tests of fitness for school, as well as certain group tests of reasoning. Examples of this testing are the *skolmognadstest* in Sweden and the *Schulreife* test in Germany.

It should be remembered, furthermore, that in all countries preschools are attended in different degrees. For example, in some English-speaking countries there are nursery schools and kindergartens, but it is only a small percentage of an age group which attends. In the United States, however, about fifty percent of children attend kindergarten. In the French-speaking countries it is estimated that approximately 50 percent of an age group attend the *école maternelle* (or *jardin d'enfants*). Thus, the differences in amounts of preschooling must be borne in mind when comparing at a later stage the performance of students from countries with different mandatory ages of entry of school.

As far as previous research is concerned, there are two cross-country studies which have examined, in part, the effect of differing amounts of formal schooling to which children in different countries have been exposed. Anderson (1964) has suggested that the superiority of the performance of English and Scottish children over American students at the age of seven can be attributed to the extra year of schooling. But when differences occurred at ages ten and fourteen, he preferred to explain these in terms of differences in instruction. Similarly, Pidgeon (1958), although finding English 11-year-old children superior to 11-year-old California children (English mean = 29.1, standard deviation = 18.7 and California mean = 12.1, standard deviation = 6.8 on a 70 item test), states that the main reasons for the different levels in performance are probably due to the fact that formal teaching tends to be introduced at an earlier age in England, and to the fact that there is a difference in the standards in the two systems. He points out that in the United States more limited objectives are formulated for children of primary school age and less emphasis is placed on progress in mechanical arithmetic than is customary in England.

A national study which has relevance to this problem was carried out by Mogstad (1958) in Norway. It occurred that 12-year-old students in a rural region of Norway were in two parallel groups. One group received the full week regular schooling for two years. The second group received formal schooling for only half this period (i.e., half the amount of formal instruction), although it must be noted that the second group undertook much more homework due to the fact that they were in sparsely populated areas and could attend school for only half the time. In specially constructed achievement tests, the second group was only slightly inferior in performance at the end of the two years to the first group, even though the number of periods devoted to each subject was half.

The IEA Study is the first study undertaken where it has been possible to examine differences between the performance of fully representative samples from more than three countries in a particular school subject. Here, it has been possible to compare the performances of 13-year-olds in countries having mandatory ages of entry to school at five (two countries), six (six countries), or seven (two countries).

The two populations which it is relevant to examine in connection with this problem are the 13-year-olds in each system (i.e., the 1a Population) and students in the grade where most 13-year-olds are to be found (i.e., the 1b Population).

The 1a Populations are chronologically comparable and are directly related by age to the mandatory age of entry to school. If the various lengths of schooling up to the age of thirteen years make a difference, then it should be apparent in this analysis.

The second population is the grade population in which most 13-year-olds are to be found. Two extra countries to those in Population 1a are represented in Population 1b and for this reasons the 1b results are also presented. The actual grades tested have been given in Chapter 4. Although the standard deviations of age for Populations

Table 7.2. *Mean ages and standard deviations of age for populations 1a and 1b.*

Country	Population 1a: Mean age in months	Population 1a: Standard deviation	Population 1b: Mean age in months	Population 1b: Standard deviation
Australia	161	3.5	159	7.7
Belgium	162	3.3	168	8.8
England	162	3.3	172	4.2
Fed. Rep. of Germany	—	—	164	6.6
Finland[1]	163	3.3	167	6.7
France	162	3.5	163	7.8
Israel	—	—	167	5.6
Japan	161	3.4	161	5.4
Netherlands	163	3.1	157	11.6
Scotland	160	3.5	168	3.4
Sweden	163	3.4	164	4.9
U.S.A.	163	3.5	164	6.8
Median	162	3.4	164	6.7
Range	3	0.4	15	8.2

[1] See note on Finnish data on page 6.

1a and 1b have already been given in Chapter 6, they are repeated here in Table 7.2 together with the mean ages of these populations in each country.

In Table 7.3, countries are grouped into three groups according to whether the mandatory age of entry is five, six, or seven years of age. The median age of entry for each country is given. The source for these figures is the National Case Study Questionnaire. Table 7.3 also gives the means, standard deviations and number of students for the various groups. The averages for the different groups of countries are simple and not weighted averages. If averages were weighted according to the number of students tested in each country, they would be biassed towards the averages of those countries where most students were tested. This is not what is required, but straight averages with each country regarded as a single observation.

It is interesting to note that although the regulations for entry to school in England and Scotland differ, the actual median age of entry is the same. In England, the regulation is that children who will become five years of age up to and including the first day of

Table 7.3. *Mean scores and standard deviations of scores in mathematics for different ages of entry.*

Country	Mandatory age of entry	Median age of entry	Population 1a: M	Population 1a: S.D.	Population 1a: N	Population 1b: M	Population 1b: S.D.	Population 1b: N
England	5 yrs	5 yrs 2 mo.	19.2	17.0	3012	23.7	18.5	3148
Scotland	5 yrs	5 yrs 2 mo.	19.1	14.6	5256	22.3	15.7	5718
			19.2			23.0		
Australia	6 yrs	5 yrs 7 mo.	20.2	14.0	2916	18.9	12.3	3078
Belgium	6 yrs	6 yrs 2 mo.	27.7	15.0	1686	30.4	13.7	2644
Fed. Rep. of Germany	6 yrs	6 yrs 5 mo.	—	—	—	25.5	11.6	4476
France	6 yrs	6 yrs 0 mo.	18.3	12.4	2410	21.0	13.2	3549
Israel	6 yrs	6 yrs 0 mo.	—	—	—	32.3	14.7	3232
Japan	6 yrs	6 yrs 0 mo.	31.2	16.9	3049	31.2	16.9	2049
Netherlands	6 yrs	6 yrs 5 mo.	23.9	15.9	428	21.4	12.1	1444
U.S.A.	6 yrs	6 yrs 5 mo.	16.9	12.7	6231	17.9	13.3	6544
			23.0			24.8		
Finland[2]	7 yrs	6 yrs 8 mo.	15.4	10.8	1156	16.1	11.6	1325
Sweden	7 yrs	7 yrs 0 mo.	15.7	10.8	2553	15.3	10.8	2828
			15.6			15.7		

[2] See note on Finnish data on page 6. In Table 7.3 the scores given for Finland are the corrected scores.

next term begin school on the first day of this term. In Scotland, it is those children who have become five years of age since the beginning of last term who begin school the first day of this term. Thus, one would expect the median age of entry to be about 4 years 10 months in England, and 5 years 2 months in Scotland. However, it would appear that because of a shortage of places in Infants Schools in England, there is a delay in children's entering school.

The differences in means are listed in Table 7.4.

Table 7.4. *Differences between mean scores of groups with different ages of entry.* (Populations 1a and 1b).

Population	6 yrs v. 5 yrs	7 yrs v. 6 yrs	7 yrs v. 5 yrs
1a	3.8	−7.4	−3.6
1b	1.8	−9.1	−7.3

The application of the test of the difference being more than twice the complex standard error of sampling indicates that all the differences are statistically significant and that countries with an entrance age of six produced, on average, higher scores than those where children enter school at 5 or 7 years of age. There is little difference between the two countries with a 5 year entry; a weak majority of countries with a 6 year entry do better than these two, but the two countries with a 7 year entry do worse. This suggests that some loss attends delaying the entry until 7 years.

Age of Entry and Social-Status Groups

It was possible to break down the scores for Population 1a by social status groups. Table 7.5 presents the scores for social groups 1–6 and for groups 7, 8 and 9 separately. The definitions of these social groups are given in full in Volume I, Chapter 8 of Husén *et al.* (1967). The following is a brief description of each:

Group 1—Higher Professional and Technical
Group 2—Administrators, Executives and Working Proprietors; *large and medium scale*
Group 3—Sub-Professional; Technical
Group 4—Small Working Proprietors (other than in agriculture, forestry, or fishing)
Group 5—Proprietors and Managers in Agriculture, Forestry, Fishing
Group 6—Clerical and Sales Workers (lower levels of white collar work)
Group 7—Manual Workers: Skilled and Semi-Skilled
Group 8—Labourers (hired) in Agriculture, Forestry, Fishing
Group 9—Unskilled Manual Workers (excluding agriculture, forestry, fishing)
Group 0—Unclassified; No Answer

Although it would appear that children from social groups 1 to 6 (professional and white-collar workers) benefit more from early entry to school than do children from groups 7 to 9 (farmers and blue-collar workers), it is difficult to draw firm conclusions because of the heterogeneity of scores within each of the age entry groups. There are some interesting differences between social groups within countries in Table 7.5. Group 7 in Finland has a higher score than Groups 1 to 6.[3] The direction of the scores in Groups 7 to 9 in England is contrary to expectation (although the differences are not statistically significant).

The actual differences in scores from Table 7.5 are reported in Table 7.6.

Table 7.5. *Mean score in mathematics by social-status group.*

(Population 1a)

	Groups 1–6			Group 7			Group 8			Group 9		
Country	M	S.D.	N	M	S.D.	N	M	S.D.	N	M	S.D.	N
England	29.54	17.19	931	15.50	14.69	1764	16.09	11.66	50	27.61	17.32	10
Scotland	26.33	14.88	1456	17.13	13.57	3180	17.04	13.77	122	13.27	12.54	171
Total	27.90	16.03	2387	16.81	14.13	4944	16.56	12.71	172	20.44	14.93	181
Belgium	31.62	14.17	863	24.83	14.72	662	24.49	21.99	9	21.19	13.92	107
France	21.88	13.31	895	16.85	11.09	1249	15.27	10.59	39	13.82	12.05	80
Netherl.	29.47	16.21	210	19.28	13.70	185	14.64	9.97	20	21.01	18.24	8
Japan	33.30	16.61	1406	28.05	16.27	485	23.07	14.87	45	21.68	17.52	24
U.S.A.	20.17	13.62	2916	13.89	12.06	2645	12.23	10.45	102	12.89	11.78	28
Australia	23.68	13.93	1380	18.15	13.18	1219	13.55	12.80	79	14.34	10.79	110
Total	26.69	14.64	7670	20.10	13.50	6445	17.21	13.44	294	17.49	14.05	357
Finland*	23.87	9.53	407	24.17	10.12	301	18.17	11.33	9	17.19	9.79	25
Sweden	17.62	11.13	1226	14.45	10.15	1075	11.42	7.92	99	12.21	8.33	49
Total	20.74	10.33	1633	19.41	10.13	1376	15.07	9.62	118	14.70	9.06	74

* The data here are the uncorrected Finnish data. It has not been possible to rerun these data since the mistake in the Finnish data was discovered.

Table 7.6. *Differences between mean scores in Table 7.5.*

(Population 1a)

	Groups 1–6	Group 7	Group 8	Group 9	Groups 8 and 9 combined
5 yrs v. 6 yrs	1.21	**−3.79**	−0.65	2.95	1.19
5 yrs v. 7 yrs	**7.16**	**−3.10**	1.49	5.74	3.62
6 yrs v. 7 yrs	**5.95**	0.69	2.14	2.79	2.43

[3] This is more likely to be a result of incorrect weighting than a realistic fact—see note on Finnish data on page 6.

It is clear that to make the mandatory age of entry to school earlier (e.g. from 6 to 5) will not in itself improve performance; it is what happens in that extra year which is important. This is particularly true for the children of bluecollar workers. It is the qualititative differences which must now be the subject of more systematic research.

Further Analyses Related to Age of Entry

It has been pointed out in Chapter 3 in Volume II of Husén *et al.* (1967) that "when the 3a Population scores are adjusted for differences in the proportions of an age group still at school, it is found that the gains between 1a and 3a stages are directly related to the time interval between the two stages, the rate of gain being the same in practically all of the countries". In other words, the differences in scores between countries are already established by the age of 13.

Since this book is concerned with organizational aspects of educational systems, it is worthwhile examining the relationship of certain other organizational features in addition to age of entry to school to the differences in mathematics scores between countries of 13-year-old students.

The number of subjects studied in grade 8 (the grade where most 13-year-olds were to be found) is of interest. Is, for example, the studying of fewer subjects associated with higher scores at this level? The number of subjects on average studied in each school was collected by means of the School Questionnaire. The figure given in Table 7.7 is the average for each country. There is considerable difference in the length of preservice training of teachers as between countries; this information consisting of the number of post-secondary school years preservice training was collected from the Teacher Questionnaire. Within countries, interest in mathematics accounts for a considerable amount of the variance and it is therefore of interest in a between countries analysis. The interest score was derived from various pieces of information collected in the Student Questionnaire. The higher the score the greater the interest. (The derivation of this index is explained in detail on pages 212–213 in Volume I of Husén *et al.*, 1967). There is also considerable variation between countries on the number of hours a week spent both in school and on homework. These data were collected through the Student

Table 7.7. *Mean mathematics score and measures of various independent variables.* (Population 1a)

Country	Total math. score (1)	Age of entry (2)	No. of subjects grade 8 (3)	Pre-service training (4)	Inter. in math. (5)	Hrs school per wk in math. (6)	Hrs home-work per wk in math. (7)
Australia	20.18	6.0	8.7	2.8	59	38	24
Belgium	27.74	6.0	8.9	2.4	57	62	36
England	19.31	5.0	8.9	3.1	57	38	17
Finland	15.39	7.0	9.0	3.2	58	30	24
France	18.32	6.0	8.5	2.1	55	45	34
Japan	31.16	6.0	9.0	3.2	61	39	30
Netherlands	23.86	6.0	9.0	4.1	54	44	26
Scotland	19.05	5.0	8.2	4.0	53	43	23
Sweden	15.70	7.0	9.0	4.6	58	57	19
U.S.A.	16.15	6.0	7.3	4.4	62	47	31
Grand mean	20.69	6.0	8.65	3.39	57.40	44.30	26.40
Grand S.D.	5.31	0.67	.54	0.85	2.88	9.40	6.24

Questionnaire and again the higher the number the greater the number of hours.[4]

Table 7.7 presents the data on each of the above variables as well as on Mean Mathematics Score for Population 1a. For convenience, columns 5, 6 and 7 have been multiplied by ten. The data are presented only for those countries for which data on all of these variables are available.

Table 7.8 presents the product-moment correlation matrix from Table 7.7. Table 7.9 presents the simple correlations, regression coefficients and their products multiplied by 100.

With as many as six constants fitted to ten observations it is clear that the multiple correlation will be rather spuriously high. None the less the regression coefficients are perhaps worth some attention. Let us take them in turn. The large negative coefficient for "age of entry" reflects chiefly the fact (see Table 7.3) that the countries delaying age of entry until the age of seven are low scorers. The large

[4] For detailed information on how the data in this paragraph were collected (except for "Interest in Mathematics") see Appendix II of Volume I of Husén *et al.*, 1967).

Table 7.8. *Product-moment correlation matrix of Table 7.7.*

	1	2	3	4	5	6	7
1	1.000	−.228	.377	−.334	.070	.180	.452
2		1.000	.276	.137	.348	.106	.080
3			1.000	−.301	−.249	−.068	−.268
4				1.000	.097	.110	−.462
5					1.000	−.071	.139
6						1.000	.356
7							1.000

Table 7.9. *r, b and rb 100 of Table 7.8.*

	r	b	rb 100	
Age of entry	−.228	−.894	20.38	$R^2 = 0.967$
No. of subjects in grade 8	.377	1.208	45.54	$R = 0.983$
Pre-service training	−.334	.622	−20.77	
Interest in math.	.070	.465	3.25	
Hours school per week in math.	.180	−.067	−1.21	
Hours homework per week in math.	.452	1.096	49.54	
Total variance accounted for			96.73	

positive coefficient for "number of subjects in Grade 8" reflects chiefly the fact that the United States is a low scoring country. It is only in the United States that the number of subjects differs by more than 1 from the general average. This is the analytical explanation of this high coefficient but it is hard to believe that this fact in itself can be a main part of the reason why the United States is a low scorer; it seems much more likely that this is not a case where A is the cause of B or vice-versa, but rather a case where A and B are both caused by something else.

The high coefficient for "pre-service training" is on a different footing; common sense suggests that there may well be a causal relation here. "Interest in Mathematics" has a high coefficient, which may well correspond to a causal relation, though the direction is less

clear. Does interest in mathematics promote good performance, or good performance promote interest in mathematics? It is possible for observers to hold different views on this. The remaining high coefficient is for "hours of homework per week" and this strongly suggests a causal relation.

One important independent variable within countries proved to be the teachers' rating of the student's opportunity to learn the items in the test (see Husén *et al.*, 1967). Each teacher was asked to rate on a three point scale the proportion of his students taking the test having had the opportunity to learn each item.[5] These data were then averaged percentwise for each country. Table 7.10 presents these data for the eight countries where they were available as well as repeating in addition the measures of pre-service training, interest and hours school per week which have already been used above.

The most striking feature of Table 7.12 is the large contribution made by "Opportunity to learn". What can this mean? The face meaning is clear enough. In the low scoring countries fewer boys and girls had covered the subject matter of the tests. Can the reason

Table 7.10. *Mean mathematics score and measures of pre-service training, opportunity to learn, interest and hours school per week in Mathematics.*

(Population 1a)

Country	Total math. score (1)	Pre-service training (2)	Opp. to learn (3)	Interest in math. (4)	Hours school per week in math. (5)
England	19.31	3.1	60	57	38
Finland	15.39	3.2	47	58	30
France	18.32	2.1	50	55	45
Japan	31.16	3.2	63	61	39
Netherlands	23.86	4.1	52	54	44
Scotland	19.05	4.0	51	53	43
Sweden	15.70	4.6	37	58	57
U.S.A.	16.15	4.4	48	62	47
Grand mean	19.90	3.59	51.00	57.25	42.87
Grand S.D.	5.31	.83	8.00	3.20	7.81

[5] For further details see Chapter 4 of Volume II of Husén *et al.*, 1967.

Table 7.11. *Product-moment correlation matrix of Table 7.10.*

	1	2	3	4	5
1	1.000	−.176	.751	.093	−.194
2		1.000	−.473	.157	.526
3			1.000	.078	−.572
4				1.000	−.010
5					1.000

be merely that the choice of subject matter of the tests was unsuitable for these countries and that they might have done better had there been a different choice of subject matter. On the whole this seems unlikely. It is certainly less likely at this level than at the higher level (Population 3a). At the higher level there is much difference of opinion, both within countries and between countries, about what the mathematical curriculum ought to be but about the curriculum at the age of thirteen there is a fairly close consensus. It seems likely therefore that in countries where the index for "Opportunity to learn" was low the students have made less progress in covering a broadly international curriculum than those in countries where the index was high. The countries where the index is low are the countries where compulsory schooling extends longer. They are in fact the United States, Sweden and Finland. In the two Scandinavian countries compulsory schooling does not begin until seven. In the United States the proportion staying on after the compulsory stage of schooling is high. A late entry would account for the fact

Table 7.12. *r, b and rb 100 of Table 7.11.*

	r	b	rb 100	
Pre-service training	−.176	.132	−2.32	$R^2 = 0.658$
Opp. to learn	.751	.984	73.90	$R = 0.811$
Interest in math.	.093	—	—	
Hours school per week in math.	−.194	.298	−5.78	
Total variance accounted for			65.80	

that less progress has been made through the curriculum by the age of thirteen. A late age of leaving might also account for it on the ground that there is still a lot of schooling to come after the age of thirteen.

Summary

The number of subjects studied by pre-university students studying mathematics ranges from an average of three in England to nine or more in several other systems of education. When a comparison is made between the mean scores of mathematics students from those systems where eight or more subjects are studied and those where four or fewer are studied, there is no significant difference in score. The conclusion that specialization, in the sense of restricting the number of subjects studied in the pre-university year, is not necessarily related to higher scores in mathematics, must be of interest to educational policy makers and planners in those countries where on average only few subjects are studied. In those countries where more subjects are studied, the age of terminating secondary schooling tends to be higher, and those countries where the age of terminating secondary schooling is lower tend to be those where the mandatory age of entry to school is lower.

The mandatory age of entry to school is five in England and Scotland, seven in Sweden and Finland, and six in the other systems paticipating in this study. The different degrees of pre-school attendance in the different systems are pointed out. When a comparison of mean scores of 13-year-old students with different ages of entry is made, differences are in favour of those entering at the age of six, but it must be remembered that the six year of entry scores are very heterogeneous. The average of the 13-year-old scores in Sweden and Finland (the latter, unweighted scores) is considerably lower than the average of the 13-year-olds with an age of entry of either six or five years.

Again, although it is easy to pick out pairs of countries to demonstrate that earlier age of entry would mean higher scores, the overall conclusion must be that age of entry at five or six is not associated with mathematics score at age 13. The extra year of schooling employed by those entering at five would not appear to be of consequence as far as progress in mathematics is concerned, whereas the loss of a year's schooling between six and seven appears to have a detrimental effect.

Although it would appear that children from professional and white-collar social groups benefit more from early entry to school than do children from farmer and blue-collar social group, it is difficult to draw firm conclusions because of the heterogeneity of scores within each of the age of entry groups. However, this finding is not surprising, since it is to be expected that higher social group parents are likely to take more advantage than lower social group parents in a system with a fixed age of entry, since they are geared to that age of entry. It would be interesting to examine whether lower social group children really did score higher when given the chance to have earlier entry to school than some of their peers within a country.

It is, however, clear that to make the mandatory age of entry to school earlier will not, in itself, improve performance. It is what happens in that extra initial year which is important and it is the qualitative differences which must now be the subject of more systematic research.

In an attempt to discover if other aspects of school organization were likely to be of more importance when trying to account for differences between countries in scores of 13-year-olds, certain features were selected where there was known to exist considerable difference in practice between countries. The features chosen were number of subjects studied in the grade where most 13-year-olds were to be found in the school system, pre-service training of teachers, hours school per week and student's opportunity to learn the items on the test (i.e. the student's programme). Two other variables which pertain to some extent to the school and to some extent to the home were also chosen. They were "interest in mathematics" and "hours homework per week".

The correlations between these variables and national mean scores provided evidence of association. The regression equations suggest that the strongest evidence of association lay between the mean scores and the amount of pre-service teacher training, the amount of homework and the extent of the opportunity to learn. Evidence of association is not of itself evidence of a causal relation but it seems reasonable enough to think that in these cases the relation is causal.

From other national research (cf. Peaker, 1967) it is known that for primary school children within England school variables account

for about only twenty percent of the variance, whereas home variables (including parental attitudes and aspirations as well as socio-economic variables) account for about fifty percent of the variance. It is therefore suggested that in future international research school variables should be taken in conjunction with home variables when trying to account for differences between countries. It may turn out, of course, for home variables that unlike their contribution within countries, their contribution between countries is small.