INDICATOR A7

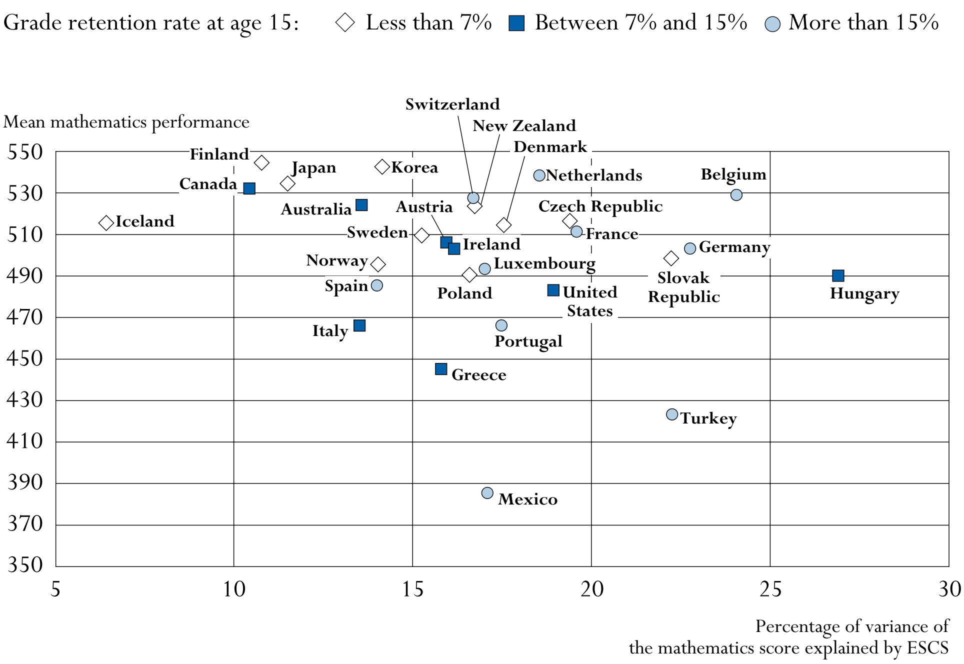
INSTITUTIONAL DIFFERENTIATION, SOCIO-ECONOMIC STATUS AND 15-YEAR-OLD STUDENTS' MATHEMATICS PERFORMANCE (2003)

As previous analyses of data from PISA have shown, socio-economic background accounts for a sizeable proportion of variance in mathematics performance. Some socio-economic background influences are attributable to the impact of student sorting or selection on the basis of differentiation practices in schools. This indicator examines the relative influence of socio-economic background and three forms of institutional differentiation on student mathematics performance on the PISA 2003 mathematics literacy assessment, and provides evidence on various forms of institutional differentiation and the proportion of variance in student mathematics performance that is associated with these practices relative to the proportion of variance that is attributable to students' socio-economic backgrounds.

Key results

Chart A7.1. Performance and variance in mathematics attributable to socio-economic status, by prevalence of grade retention in OECD countries

In countries in which larger proportions of 15-year-old students have repeated the school year, the impact that social background has on mathematics performance tends to be stronger.



Source: OECD PISA 2003 database. Table A7.1.

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Other highlights of this indicator

- The relationship between mathematics performance and between-school differences is stronger in countries that offer more distinct education programmes. For example, in countries with one or two programmes, the proportion of variance in mathematics performance associated with differences between schools is 19.2% compared with 42.2% in countries offering four or five programmes.
- On average, differences between grades (related largely to the degree to which students have been retained at some point during their school careers) account for less of the variance in mathematics performance than do differences between schools and differences between programmes. However, the relationship between mathematics performance and between-grade differences is generally stronger among countries in which higher percentages of students have repeated a school year, even though in some countries different starting ages for schools in different regions also play a role.
- Across OECD countries, as the number of distinct education programmes available to 15-year-olds increases, the proportion of variance in mathematics scores associated with socio-economic background also tends to increase. The average proportion of variance in mathematics scores accounted for by differences in students' socio-economic background ranges from 13.8% in countries with one or two programmes to 19.3% in countries with four or five programmes.

Policy context

Catering for the diverse needs of students and narrowing the gaps in their performance represent formidable challenges for all countries. Countries have chosen various approaches to address these demands. Some countries have comprehensive school systems with no, or only limited institutional differentiation. They seek to provide all students with similar opportunities for learning by requiring each school and teacher to provide for the full range of student abilities, interests and backgrounds. Other countries respond to diversity by grouping students through tracking or streaming, whether between schools or between classes within schools, with the aim of serving students according to their academic potential and/or interests in specific programmes. And in many countries, combinations of the two approaches occur.

Even in comprehensive school systems, there may be significant variation in performance levels between schools, due to practices in which students are sorted on the basis of interest or ability through curriculum tracking or grade retention, or due to the socio-economic and cultural characteristics of the communities that are served, or geographical differences (such as between regions, provinces or states in federal systems, or between rural and urban areas). Finally, there may be differences between individual schools that are more difficult to quantify or describe, part of which could result from differences in the quality or effectiveness of the instruction that those schools deliver. As a result, even in comprehensive systems, the performance levels attained by students may still vary across schools.

How do the policies and historical patterns that shape each country's school system affect and relate to the variation in student performance between and within schools? Do countries with explicit tracking and streaming policies show a higher degree of overall disparity in student performance than countries that have non-selective education systems? Research on curriculum tracking and other forms of institutional differentiation suggests that the greater the differentiation of students' educational experiences, the more their educational outcomes will be socially stratified (Garet and Delaney, 1988; Lucas, 2001; Ready, Lee and Welner, 2004). This suggests that some portion of socio-economic background influences might be attributable to the influences of differentiation practices. This indicator explores the influences of several forms of institutional differentiation on students' mathematics literacy relative to the influence of their socio-economic backgrounds.

Evidence and explanations

This indicator examines three features of countries' education systems related to differentiation among students. The first feature is the number of distinct programmes that are included in the secondary education system and that are available to 15-year-old students. The second feature is the students' age at the time of their first decision to continue to the next stage of a country's secondary education process or to select (or be selected for) educational programmes. The third feature is the degree to which countries engage in the practice of retaining students to repeat a grade (grade retention).

The indicator provides descriptive information about countries on these features, as well as information on the proportion of variance in mathematics performance that is associated with between-school differences, between-grade differences, and between-programme differences. The variances associated with these structural factors also are discussed relative to the proportion of variance in mathematics performance that is attributable to differences in students' socio-economic background.

Table A7.1 presents the three institutional differentiation practices examined in this indicator for the OECD countries reporting results. Columns 1 and 2 present statistics on student mathematics performance for each country: the mean and the standard deviation of the distribution of mathematics performance. Columns 3 to 5 display the institutional differentiation practices in which countries engage. Column 6 shows the proportion of variance in socio-economic background – measured by the PISA index of students' economic, social and cultural status (ESCS) – that is attributable to differences between schools. Columns 7 to 9 display the proportion of variance in mathematics scores that is associated with differences between schools, differences between grades, and differences between programmes. Column 10 shows the proportion of variance in mathematics scores that is attributable to socio-economic background differences; this percentage indicates the strength of the relationship between mathematics performance and socio-economic background. Countries are presented in ascending order, first, by the number of distinct programmes or school types countries offer to 15-year-olds (column 3) and, second, by the total variance in mathematics performance attributed to differences in socio-economic status (column 10).

The relative influence of the number of distinct programmes available to 15-year-olds, age at first selection and socio-economic background on student mathematics performance

One device to differentiate among students is the use of different institutions or programmes that seek to group students, in accordance with their performance or other characteristics. Sorting students according to their performance often assumes that their talents will best develop in a learning environment where their intellectual stimulation is equal, and that an intellectually homogeneous student body will favour effective teaching. Looking first at the number of distinct programmes, Table A7.1 shows that OECD countries vary: some have essentially undivided secondary education until the age of 15 years, others have four or more school types or distinct educational programmes (Austria, Belgium, the Czech Republic, Germany, Ireland, Luxembourg, the Netherlands, the Slovak Republic and Switzerland). Simple cross-country comparisons show that, while the number of school types or distinct educational programmes available to 15-year-olds is, across countries, not related to average country performance in mathematics, it accounts for 39% of the share of the OECD average variation that lies between schools (see Figure 5.20b in *Learning for Tomorrow's World – First Results from PISA 2003,* [OECD, 2004a]). No less important, it accounts for 26% of the cross-country variation among countries in the strength of the relationship between socio-economic background and student performance. In other words, in countries with a larger number of distinct programme types, socio-economic background tends to have a significantly larger impact on student performance. It is therefore much harder to achieve equity.

An important dimension of tracking and streaming is the age at which decisions between different types of school are generally made, and the impact this has on students and their parents who are faced with these choices. Such decisions occur very early in Austria and Germany, at around age 10. By contrast, in countries such as New Zealand, Spain and the United States no institutional differentiation takes place, at least between schools, until the completion of secondary education. There is no statistically significant correlation between the age of selection and country mean performance in mathematics. However, the share of the OECD average variation in student performance that lies between students and schools tends to be much higher in countries with early selection policies. In fact, the age of selection accounts for half of the between-school differences. While this, in itself, is not surprising because variation in school performance is an intended outcome of stratification, the findings also show that education systems with lower ages of selection tend to show much larger social disparities, with the age of selection explaining 28% of the country average of the strength of the relationship between the PISA index of economic, social and cultural status and student performance in mathematics.

Box A7.1. Notes on data

This indicator uses data from the PISA 2003 mathematics literacy assessment (for mathematics performance statistics), the student background questionnaires (for percentage of students retained in grade by age 15) and macro-level data provided by PISA National Project Managers (for number of distinct educational programmes and students' age at first selection). This box provides information on the macro-level data sources. Notes on the student background data are presented in the text in the final section of the indicator

In this indicator, number of programmes refers to the number of distinct programmes that are available to students at age 15 and which can be defined in relation to the International Standard Classification of Education (ISCED) levels. One inconsistency to point out in the table accompanying this indicator is that, in some countries with a single, comprehensive education programme, a small proportion of the variance in mathematics scores is attributable to differences between programmes. In these cases, despite there being only one distinct programme, implicit differentiation practices (particularly curriculum tracking) within the programme are accounting for the variance in students' performance in mathematics that between-school differences do not pick up.

Table A7.1 also illustrates the extent to which the number of programmes or school types is related to between-school differences in mathematics performance. Across OECD countries two general patterns emerge.

First, the relationship between student mathematics performance and between-school differences is generally stronger in countries that offer more distinct programmes or school types. The average strength of the relationship between mathematics performance and between-school differences in one- and two-programme countries is 19.2%, compared to 41.9% and 42.2% in countries offering three and four or five distinct programmes, respectively.

Second, the variance in mathematics scores attributable to between-school differences and the variance in mathematics scores attributable to between-programme differences are positively related: high proportions of variance in mathematics scores attributable to between-school differences tend to be accompanied by high proportions of variance in mathematics scores attributable to between-programme differences. (The converse is true as well, with low proportions of variance in mathematics scores attributable to between-school differences accompanied by low proportions attributable to between-programme differences.) With the exception of single-programme countries, this suggests that between-programme differences make up a considerable proportion – at least half, if not more for most countries – of the variance in mathematics scores that is being attributed to between-school differences.

There are a number of interesting exceptions to this pattern, however. In four countries, Belgium Luxembourg, the Netherlands and Portugal, between-programme differences account for a greater proportion of variance in mathematics scores than between-school differences. In these countries, school differences may be all programme differences. Another exception is Japan in which between-school differences account for a much greater portion of variance in mathematics scores than between-programme differences. With two distinct programmes, between-school differences account for a sizeable 53% of differences in student mathematics performance, yet between-programme differences account for only 4.8%. This suggests that in Japan, schools within distinct programmes are more differentiated than they are across Japan's two programmes. Examining the different proportions of variance in mathematics scores attributable to different features of countries' educational systems relative to one another offers insight into how student learning may be taking place, and the features of education systems that may facilitate or hold back mathematics performance. When interpreting the data, the Netherlands provide an interesting case, in which the overall performance of students is so high, that even the lower performing students do relatively well in an international comparative perspective.

The relative influence of grade retention by age 15 and socio-economic background on mathematics performance

The third form of institutional differentiation examined in this indicator is the practice of grade retention. As defined by Jackson (1975), "grade retention is the practice of requiring students who have been in a given grade level for a full year to remain at that grade level for a subsequent year". The practice is generally used by schools to remediate poor academic performance, though it may also be used – particularly in the lower grades – to retain students who are judged too young or too immature compared to their peers to proceed.

As with other forms of institutional differentiation, grade retention is considered by some, primarily teachers and administrators, to be an effective and efficient strategy for facilitating learning and raising performance, as struggling students are grouped together in homogeneous classes where instruction can be delivered more to their level. Additionally, retention often operates as an incentive for students to study (Cosnefroy and Rocher, 2004). Despite the popularity of retention, considerable research has shown that retained students are no more likely to perform well than their non-retained, similarly achieving classmates (Jimerson, 2001).

Table A7.1 shows the percentage of 15-year-old students who have repeated at least one grade, based on students' responses to the PISA background questionnaire. Because these figures are based on self-reports and because students' answers reflect the entirety of their educational experiences (which, for small percentages of students, may not have occurred in their present systems), they are a proxy for their countries' actual retention policies.

As the table shows, three countries clearly do not have a retention policy (Iceland, Japan, and Norway), with no students reporting having repeated a grade by the age of 15. Additionally, eight countries have only a limited number of students having repeated a grade, including: the Czech Republic, Denmark, Finland, Korea, New Zealand, Poland, the Slovak Republic and Sweden.

In at least two of those countries, Sweden and New Zealand, there is no explicit retention policy, so the small percentages of students in those countries reporting having repeated a grade may be reflective of other factors.

However, in the majority of OECD countries, grade retention is much more prevalent, with the percentage of students reporting having repeated a grade ranging from 7% in Greece up to 38% in France. Grouping these countries further, eight countries have between 7 and 15% of students reporting having repeated a grade, while ten countries (one-third of all OECD countries) have over 15% of students having repeated a grade. The three groupings of countries emerge from an examination of the data and knowledge of countries' retention policies. In general, countries in which fewer than 7% of students are retained tend to have automatic promotion policies or no explicit policies related to retention, whereas countries in which over 15% of students have been retained tend to have explicit, long-standing policies and a culture in which retention is a common feature.

Chart A7.1 illustrates where countries in these groupings fall along the dimensions of mean mathematics performance and the percentage of variance in mathematics scores attributable to students' socio-economic backgrounds, which represents the strength of the relationship between mathematics performance and socio-economic background (measured with the ESCS index).

Across the percentage groupings (*i.e.* less than 7%, 7 to 15%, and over 15%), between-grade differences (retention), on average, account for less variance in student mathematics performance than both between-school differences and between-programme differences (and socio-economic background, but more will be said separately on this issue). Across countries in which less than 7% of 15-year-olds have repeated a grade, the proportion of variance in mathematics scores attributable to retention is, on average, 3.9%, compared to 8.5% for countries in which 7 to 15% of 15-year-olds have repeated, and 24% for countries in which more than 15% have repeated. By contrast, the proportion of variance in mathematics scores accounted for by between-school differences is 23.1%, 35.0%, and 41.0% and the proportion of variance in mathematics scores attributable to between-programme differences is 9.0%, 18.4% and 36.2%, respectively for the same groupings. Although not additive, it is not surprising to find the variance in mathematics scores attributable to between-school differences to be larger than the variances attributable to between-programme differences and between-grade differences. Variance in mathematics scores attributable to between-school differences includes variance accounted for by both programme differences and grade differences. Similarly, variance accounted for by between-programme differences encompasses variance accounted for by between-grade differences, and some, but not all, variance accounted for by between-school differences.

There are exceptions to this general pattern, and they occur among countries in which retention is among the most prevalent. In Spain and Portugal, where 28.6% and 29.5% of 15-year-olds have been retained by age 15, respectively, differences between grades account for more variance in mathematics performance than do differences between schools and differences between programmes. In Spain, with one distinct compulsory secondary education programme until age 16, this suggests a possibly high rate of multiple repeaters. Multiple repeaters are students who have been held back for several years. Their performance on the PISA mathematics assessment may be reflecting the much lower grade in which they are enrolled (and the much lower curriculum they are being taught) more so than any differences that exist among schools in

Spain. This explanation applies equally to Portugal's high proportion of variance attributable to retention. Students' performance on the mathematics assessment is reflecting the much lower grade in which they are enrolled, more so than the different schools and programmes in which they are enrolled.

The earlier examination of distinct programmes or schools types and age at first selection found that both forms of institutional differentiation are associated with an increased strength of the relationship between students' mathematics performance and socio-economic backgrounds. That is, greater social stratification in mathematics performance was observed in countries that engaged in greater differentiation. The same observation holds true for the practice of grade retention. In countries with higher a percentage of students having repeated a grade, student mathematics performance is more socially stratified. Across OECD countries in which less than 7% of 15-year-olds have been retained, students' socio-economic background accounts for 15% of the variance in students' mathematics performance. In countries in which 7 to 15% of 15-year-olds have been retained, socio-economic status accounts for 16.5% of the variance in students' mathematics performance. And, in countries retaining over 15% of their 15-year-olds, 19% of the variance in students' mathematics performance is attributable to students' socio-economic backgrounds.

Definitions and methodologies

The achievement scores are based on assessments administered in 2003 as part of the Programme for International Student Assessment (PISA) undertaken by the OECD.

The target population studied for this indicator was 15-year-old students. Operationally, this referred to students who were from 15 years and 3 (completed) months to 16 years and 2 (completed) months at the beginning of the testing period and who were enrolled in an educational institution, irrespective of the grade levels or type of institutions in which they were enrolled, and irrespective of whether they participated in school full-time or part-time.

Further references

For further information about PISA 2003, see *Learning for Tomorrow's World – First Results from PISA 2003* (OECD, 2004a), and the *PISA 2003 Technical Report* (OECD, 2005c). PISA data are also available on the PISA Web site: *www.pisa.oecd.org*.

Table A7.1.
Institutional differentiation, variance in mathematics performance, and economic, social and cultural status (ESCS), (2003)

	Performance on the PISA 2003 mathematics assessment		Differentiation practices			Variance expressed as a percentage of the total variance in ESCS in a country	Variance expressed as a percentage of total variance in mathematics scores in a country			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Mean	SD	Number of school types or distinct programmes available to 15-year-olds	Age at first selection	Percentage of 15-year-olds who have repeated at least once[1]	Total variance in ESCS attributable to differences between schools	Total variance attributable to differences between schools	Total variance attributable to differences between grades	Total variance attributable to differences between programmes	Total variance attributable to differences in ESCS
Iceland	515	90	1	16	0.0	17.4	3.8	0.0	a	6.5
Canada	532	87	1	16	9.7	17.8	17.3	10.2	a	10.5
Finland	544	84	1	16	2.8	11.4	4.8	5.4	a	10.9
Australia	524	95	1	16	9.0	26.1	21.1	6.7	a	13.7
Spain	485	88	1	16	28.6	24.8	19.7	25.3	a	14.0
Norway	495	92	1	16	0.0	11.6	6.6	0.5	a	14.1
Sweden	509	95	1	16	3.4	11.7	10.5	4.6	a	15.3
Poland	490	90	1	16	3.6	23.3	12.6	8.2	a	16.7
New Zealand	523	98	1	16	4.5	17.0	18.1	4.9	a	16.8
Denmark	514	91	1	16	3.4	19.2	13.4	5.7	a	17.6
United States	483	95	1	16	11.3	22.7	25.7	7.0	a	19.0
Japan	534	101	2	15	0.0	27.3	53.0	0.0	4.8	11.6
Greece	445	94	2	15	7.0	28.7	36.3	6.3	23.5	15.9
Italy	466	96	3	14	15.0	29.6	52.2	10.6	19.3	13.6
Korea	542	92	3	14	0.5	29.7	42.0	0.0	22.2	14.2
Mexico	385	85	3	12	28.4	34.2	39.4	19.7	22.1	17.1
Portugal	466	88	3	15	29.5	24.3	33.6	42.6	38.8	17.5
Turkey	423	105	3	11	17.3	36.9	54.9	5.9	40.1	22.3
Hungary	490	94	3	11	9.5	44.4	58.3	10.3	37.7	27.0
Austria	506	93	4	10	9.6	32.2	52.9	8.0	39.7	16.0
Ireland	503	85	4	15	13.8	21.0	15.9	9.1	8.2	16.3
Switzerland	527	98	4	12	21.6	18.7	34.2	16.2	10.3	16.8
Luxembourg	493	92	4	13	37.9	23.9	31.6	20.3	34.4	17.1
Netherlands	538	93	4	12	28.4	22.9	58.0	19.4	64.4	18.6
Germany	503	103	4	10	20.3	30.3	51.7	22.2	50.2	22.8
Belgium	529	110	4	12	29.5	31.8	46.0	32.0	59.1	24.1
Czech Republic	516	96	5	11	2.6	29.9	47.8	7.8	35.1	19.5
Slovak Republic	498	93	5	11	2.5	32.3	41.7	6.2	28.7	22.3
France	511	92	m	15	38.3	32.3	m	36.8	41.5	19.6
OECD average	***500***	***100***	-	-	***13.4***	***25.3***	***32.3***	***12.1***	***32.2***	***16.8***
United Kingdom[2]	m	m	1	16	2.1	18.4	22.3	0.9	a	19.7

Note: Countries are presented in ascending order, first, of the number of distinct programmes and, second, of the total variance in mathematics performance explained by differences in economic, social and cultural status (ESCS).
1. Data on grade retention come from student self-reports on whether or not they have ever repeated a grade; therefore they only approximate the grade retention policy and practices of any given country.
2. Response rate too low to ensure comparability. See Annex 3 for notes *(www.oecd.org/edu/eag2006)*.
Source: OECD PISA 2003 database.
Please refer to the Reader's Guide for information concerning the symbols replacing missing data.

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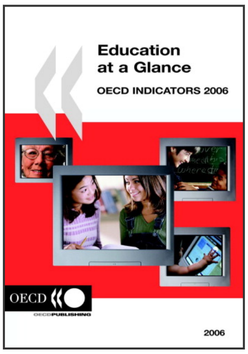

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