# Equity of achievement: A matter of education structures?[1]

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**Abstract**

This paper focuses on the issue of equality in educational outcomes. It investigates whether inequity increases between primary and secondary education, and relates variations in these patterns to the education structures of various industrialized countries. Data from IEA's Reading Literacy Study and TIMSS 2003 offered the advantage of allowing a comparison of equity within education systems at two levels of education, with the outcomes of such an investigation having the potential to identify equity changes related to institutional changes between primary and secondary education. The study investigated two hypotheses relating to these considerations. However, methodological issues did not allow a satisfactory investigation of the relationship between institutional settings and equity.

## Introduction

Industrialized societies present a double challenge for their education systems: they are required to be both effective and equitable. Education systems have to provide a stock of human capital able to meet the demanding challenges of post-industrialized economies (OECD, 2005), but at the same time they must respect the equity demands of democratic societies. Education stakeholders have to face this double constraint; they need to look for pedagogical and institutional means of fostering equity and effectiveness. In relation to this perspective, international surveys can be viewed as unique tools that enable us to analyze how efficient and how equitable countries are and then to consider this information in relation to institutional settings.

Our initial objective in the study outlined in this paper was to focus on the issue of equality in educational outcomes by investigating if inequity increases between primary and secondary education and then relating variations in these patterns to the education structures of various industrialized countries. Education systems are indeed often classified as "selective" or "comprehensive" according to the way they group their students. As Hanushek and Woessmann (2005) note, the central argument against selective systems is that they are *per se* more inequitable, offering a less demanding education environment to less able students, and using tracks (streams) to group people from socioeconomically disadvantaged backgrounds. Grisay's (2006) analysis, based on Programme for International Students Achievement (PISA) 2003 data, confirms this argument. Grisay notes that, in most comprehensive education systems, the effects of socioeconomic factors on mathematics achievement are partially cancelled out, but that these factors have a strong impact on performance in mathematics in tracked systems. Unlike the data from PISA, the International Association for the Evaluation of Educational Achievement's (IEA) Reading Literacy Study and TIMSS 2003 data offer researchers the advantage of comparing equity within education systems at two levels of education, which could help identify equity changes related to institutional changes between primary and secondary education. The first section of this paper therefore clarifies the concept of equity, and presents the working hypothesis investigated.

## Does institutional differentiation increase inequity?

In accordance with the definition proposed by the European Group of Research on Equity of Education Systems (Baye et al., 2005), not all types of inequality should be qualified as inequitable. Education has room for many kinds of inequalities (of access, achievement,

1 The authors are grateful to their colleagues Aletta Grisay and Dominique Lafontaine (University of Liège) for making comments and suggestions on earlier versions of this paper.

social actualization) (Demeuse & Baye, 2005; Grisay, 1984). Also, education systems may sometimes accept certain kinds of inequalities in order to improve equality at another level. For instance, compensatory programs waive the principle of equality of treatment in the name of more equality of achievement. Some countries may also accept a high level of dispersion of achievement results, provided that the students at the bottom of the distribution have acquired a set of basic skills. These examples illustrate the difficulty of finding a unique definition of equity in an international perspective. As the concept of equity is a matter of justice, each society may answer differently to the central equity question: which are the unfair inequalities?

To overcome the impossibility of finding a common definition of unfair inequalities in various countries, general theories of justice by various researchers and commentators have been investigated. Most of them agree on one point: *academic success in school should not depend on social origin* (Meuret, 2001). For decades, providing universal access to education was considered the best way to ensure this independence. Nowadays, in developed countries where equality of access to compulsory schooling is achieved, this independence refers to equality of achievement.

The studies conducted by the IEA have regularly shown that socioeconomic background is a powerful predictor of students' achievement, at different grades and in different cognitive areas, in all participating countries (see, for example, Elley, 1992; Mullis, Martin, Gonzalez, & Chrostowski, 2004a, 2004b; Mullis, Martin, Gonzalez, & Kennedy, 2003). However, the strength of the relationship may vary from country to country—the lower the correlation, the higher the level of equity. On the other hand, tracked (or streamed) education systems are often pointed out as inequalitarian because how the educational institutions are organized reinforces the socioeconomic inequalities (Hanushek & Woessmann, 2005). For instance, PISA 2003 data suggest that in countries with institutional differentiation (i.e., number of programs offered to 15-year-old students, age of first selection (i.e., entry into a track or stream), and rate of student retention), the relationship between socioeconomic background and achievement is stronger than it is in comprehensive systems (OECD, 2006).

With these considerations in mind, we formulated a two-step hypothesis to analyze this potential link between education structures and equity:

1. Education systems that group students according to their abilities (or any surrogate factor) tend to have a *higher correlation between the social background variables and the performance.*
2. As education systems present little variability in terms of ability grouping in primary education compared to secondary education, the *correlation between socioeconomic status (SES) and performance should increase between these two levels of education, especially in education systems with ability grouping.*

## Data and method

To test these hypotheses, we looked for IEA surveys that met the following criteria:

1. *Provided a survey of one primary education population and one secondary education population:* The IEA Reading Literacy Study 1991 and TIMSS 2003 fulfilled this condition because they surveyed students from Grade 4 (Population 1) and Grade 8 (Population 2).
2. *Included the same measure of the students' family background at both grades:* The IEA Reading Literacy Study 1991 and TIMSS 2003 met this criterion, through "the number of books in the home" variable. TIMSS 2003 also included international items on "educational resources in the home."
3. *Included education systems that differed considerably in how they grouped students within the educational institutions:* IEA Reading Literacy (1991) and TIMSS 2003 again fulfilled this condition.

In this present investigation, we considered only the developed countries (i.e., OECD and European Union members) that participated in these studies.

Although the two IEA studies met the three conditions needed to test the general hypothesis, it must be recognized that both offer a limited set of common variables to capture the social origin of the students, mainly because of the difficulty of obtaining this information from Grade 4 students. The analysis and conclusions on the equity of the education systems are therefore conditioned by the reliability of this measure. We selected "number of books in the home" from among the limited set of variables used in both studies, and for both populations, as a proxy for students' socioeconomic background. We chose this variable because it represents quantifiable

socioeconomic/cultural capital. For an examination of the methodological issues linked to this choice, see the section below headed "Is the SES Measure Reliable?"

We chose the intra-class coefficient as a measure of the homogeneity/heterogeneity of the education systems. It gives quantitative information on the tendency within education systems to have more or less homogeneous classes in terms of students' performance, a tendency which reflects explicit or implicit grouping policies. We preferred using the intra-class coefficient to other measures of homogeneity/heterogeneity, such as age of the first selection, number of tracks, and intra-class coefficient of the SES, for methodological reasons. Psychometrically, it presents the advantage of being a metric variable. Furthermore, as academic segregation is not independent from SES segregation, controlling for SES grouping should reduce the academic segregation. Kirsch, de Jong, Lafontaine, McQueen, Mendelovits, and Monseur (2002) discuss this issue of the interaction between social and academic segregation. From their analysis of PISA 2000 data, we could assume that both effects usually merge, except for countries with a high number of private schools (because parents have to pay fees to send their children to these schools) and for Korea, where academic segregation appears to be particularly important, and social segregation is low.

## Results

Based on IEA Reading Literacy Study data, Figures 1 and 2 present the relationship between the tendency for countries to group students by ability (intra-class coefficient) and their tendency to be inequitable (i.e., to have a relatively high correlation between SES and achievement). These figures show that education systems that group students according to their abilities tend to have a higher correlation between the students' social background and their performance, as confirmed by the correlation coefficients between both axes of the figures, respectively 0.43 for Population 1, and 0.31 for Population 2 (see also Table 1).

The correlation coefficients between both dimensions (homogeneity/equity) were also computed for mathematics and science, using TIMSS 2003 data (see Table 1). Even though the correlations are not perfect, the recurrence of the findings (i.e., a correlation between the tendency to be inequitable and the tendency to practice segregation) across domains and populations does support the conclusion on the link between institutional settings and equity.

However, Table 1 also shows that the correlation coefficients are higher in reading literacy and in science than in mathematics. Although we need to consider this finding with caution because of the small numbers of countries included in the analysis, it is possible that this difference is inherent to the subject domain of mathematics. Thus, the lesser effect of the socioeconomic environment on student achievement in mathematics and grouping could be because mathematics is more school-based in nature than are the other two domains.

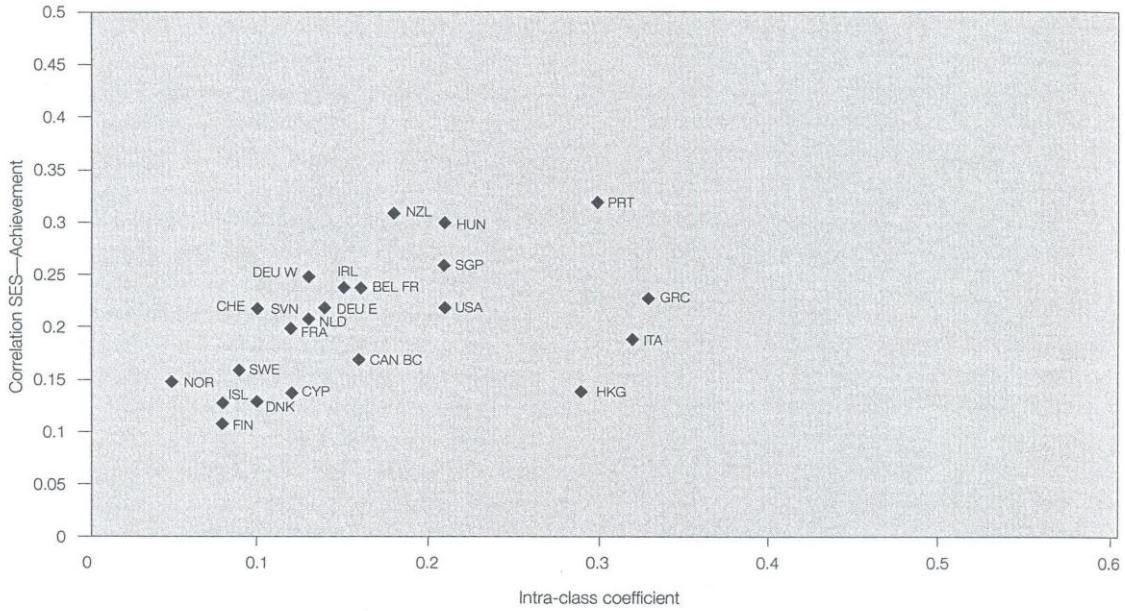
In general, our data confirmed our first hypothesis: homogeneous systems are less equitable than the heterogeneous ones because they tend to group students according to their family background. (For detailed figures, See Appendix Tables A1, A2, and A3.) But does this tendency increase between primary and secondary education? We computed the growth in the intra-class correlation between Populations 1 and 2 and the growth in the correlation coefficients between SES and performance in the two populations. The correlation coefficients between the two growths were respectively 0.04, -0.10, and 0.29 for reading, mathematics, and science.

These results did not confirm the second hypothesis, namely, that education systems with more ability grouping tend to lead to a stronger increase in the relationship between SES and performance between primary and secondary level than do the comprehensive systems. Table 2 shows that the correlation between SES and performance increased

*Table 1: Correlation between (1) Intra-class Coefficient and (2) the SES (Books) and Achievement Correlation—IEA Reading Literacy Study 1991 and TIMSS 2003*

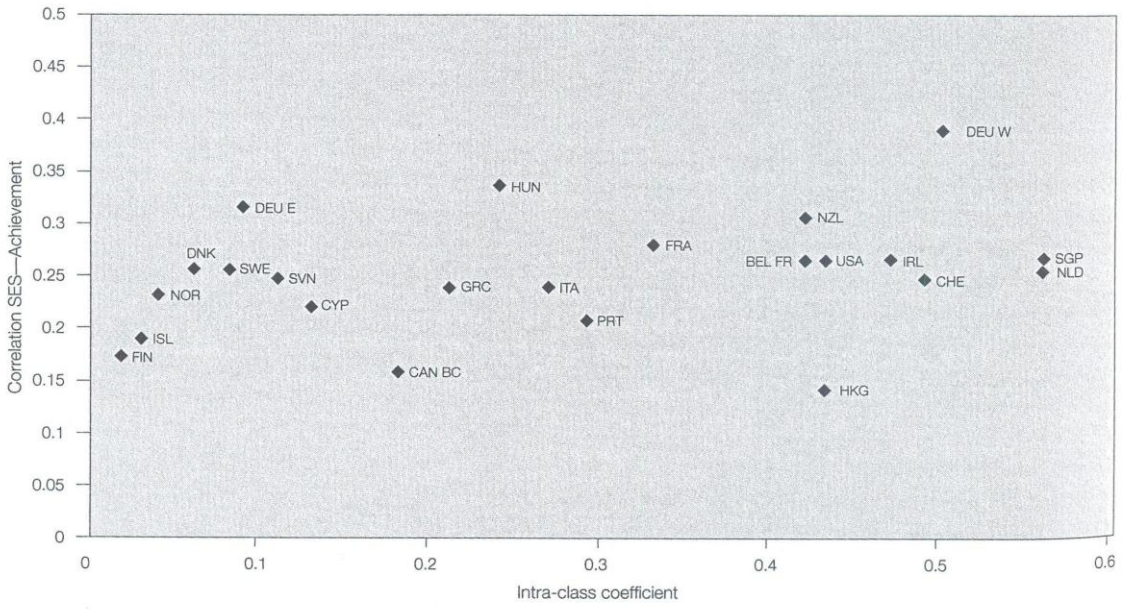
| | Population 1 | Population 2 |
|---|---|---|
| Reading Literacy (1991) | 0.43 | 0.31 |
| Mathematics (2003) | 0.33 | 0.15 |
| Science (2003) | 0.48 | 0.45 |

*Figure 1: Intra-class Coefficient (rho) and Correlation between SES (Books) and Achievement in Reading, Population 1—IEA Reading Literacy Study 1991*




*Note:* Correlation between both axes: 0.43.

*Figure 2: Intra-class Coefficient (rho) and Correlation between SES (Books) and Achievement in Reading, Population 2—IEA Reading Literacy Study 1991*




*Note:* Correlation between both axes: 0.31.

*Table 2: Correlation between SES (Books) and Achievement—IEA Reading Literacy Study 1991 and TIMSS 2003*

| | Population 1 | Population 2 |
|---|---|---|
| Reading Literacy (1991) | 0.21 | 0.30 |
| Mathematics (2003) | 0.24 | 0.31 |
| Science (2003) | 0.24 | 0.33 |

everywhere, whatever the initial level of correlation observed at the primary level. This finding led us to conclude that, in most education systems, the relationship between socioeconomic background and achievement increases between primary and secondary level, whatever the education structures.

We did not observe the divide we expected between selective and comprehensive systems. Selective systems seem somewhat more inequitable at the primary level. Moreover, their selective structures do not seem to worsen their situation with regard to equity, compared to comprehensive systems, which are more equitable at the primary level but which do not prevent an increase in the correlation between SES and achievement between both levels. We conducted further analyses to improve our understanding of this unexpected result.

## Is the SES measure reliable?

A correlation coefficient mainly relies on the latent correlation between both phenomena. Differences in the latent correlation reflect differences in the strength of the relationship. However, the observed correlation differences might also be due to differences in the reliability of the measure from country to country. Variations across industrialized countries in the reliability of the performance scale are usually small. By contrast, the reliability of the SES measure from country to country, and from one population to another, may be questioned. Because "number of books" is a single variable, one cannot directly compute the reliability of the SES measure. However, if number of books at home is a reliable proxy for students' socioeconomic backgrounds, it should not vary relative to a variable that is presumably uniformly distributed among different social groups, as is the case with gender. We accordingly computed the correlation between SES and performance for boys and girls (Table 3).

From the table we can see that, in some countries, the correlation SES/performance differs considerably between boys and girls. The correlation between books at home and achievement tends to be higher for girls at the primary level, while the differences tend to be less pronounced, or even reversed, at the secondary level. Note, however, that the increase in the SES/performance correlation between Population 1 and Population 2 correlates at 0.38 with the gender gap in the SES/performance correlation in Population 1, as shown in Figure 3. The correlation coefficient would actually increase to 0.50 if Finland was excluded.

This finding could indicate that, for Grade 4 students, number of books at home is not the best proxy to measure socioeconomic background because it is gender sensitive. For girls, identifying the number of books at home would also be a way to manifest interest in books, which could explain the higher correlation with achievement in reading literacy for girls than for boys. The general evolution of the correlations between books at home and achievement in reading may consequently be affected by this gender gap.

We confirmed the hypothesis of an interaction between an SES proxy and the domain of assessment by contrasting these results with a replication of the analysis in mathematics and science (TIMSS 2003). In mathematics, the gender gap in the correlation between books at home and achievement concerns far fewer countries (cf. Table A6 in the appendix to this paper). This measure seems to be more stable, both at primary and secondary levels. The correlation between gender differences at Grade 4 and the SES/achievement correlation between both grades is 0.05 (compared to 0.38 for reading). In science, the same correlation is also 0.05, but the pattern is different: the correlation between SES and gender tends to be better for boys in some countries, and these gender differences exist at both primary and secondary levels (cf. appendix, Table A7). Here, unlike the situation for reading, the hypothesis persists for Population 2, in that the gender interaction between the SES measure and achievement in science neither correlates with nor sufficiently explains the evolution of the SES/achievement correlation.

*Table 3: Correlation between SES (Books) and Achievement, by Gender—IEA Reading Literacy Study, 1991*

| | Population 1 | | | Population 2 | | |
|---|---|---|---|---|---|---|
| | *Boys* | *Girls* | *Difference* | *Boys* | *Girls* | *Difference* |
| Belgium (Fr) | 0.26 | 0.23 | -0.03 | 0.33 | 0.33 | 0.00 |
| Canada (BC) | 0.17 | 0.18 | 0.02 | 0.18 | 0.21 | 0.03 |
| Switzerland | 0.21 | 0.25 | 0.04 | 0.31 | 0.29 | -0.02 |
| Cyprus | 0.13 | 0.16 | 0.03 | 0.26 | 0.28 | 0.02 |
| Germany (E) | 0.18 | 0.27 | **0.09** | 0.40 | 0.37 | -0.03 |
| Germany (W) | 0.22 | 0.31 | **0.09** | 0.43 | 0.52 | **0.09** |
| Denmark | 0.11 | 0.18 | **0.07** | 0.30 | 0.33 | 0.03 |
| Finland | 0.03 | 0.22 | **0.20** | 0.22 | 0.19 | -0.03 |
| France | 0.19 | 0.23 | 0.03 | 0.32 | 0.37 | 0.05 |
| Greece | 0.26 | 0.20 | **-0.06** | 0.28 | 0.29 | 0.02 |
| Hong Kong SAR | 0.13 | 0.15 | 0.02 | 0.17 | 0.18 | 0.00 |
| Hungary | 0.31 | 0.32 | 0.01 | 0.41 | 0.39 | -0.02 |
| Iceland | 0.11 | 0.15 | 0.04 | 0.26 | 0.20 | **-0.06** |
| Ireland | 0.25 | 0.24 | -0.01 | 0.32 | 0.32 | 0.00 |
| Italy | 0.20 | 0.19 | -0.01 | 0.28 | 0.30 | 0.02 |
| Netherlands | 0.22 | 0.21 | -0.01 | 0.26 | 0.37 | **0.11** |
| Norway | 0.15 | 0.17 | 0.02 | 0.29 | 0.31 | 0.02 |
| New Zealand | 0.33 | 0.30 | -0.03 | 0.38 | 0.35 | -0.03 |
| Portugal | 0.32 | 0.34 | 0.02 | 0.25 | 0.25 | 0.00 |
| Singapore | 0.25 | 0.28 | 0.03 | 0.33 | 0.31 | -0.02 |
| Slovenia | 0.19 | 0.27 | **0.08** | 0.31 | 0.29 | -0.02 |
| Sweden | 0.13 | 0.20 | **0.07** | 0.28 | 0.35 | **0.06** |
| United States | 0.22 | 0.22 | 0.01 | 0.35 | 0.30 | -0.05 |

Because of the possible interaction between SES and gender, we searched for another proxy for SES. We subsequently developed an index of home educational resources that "combined" four items commonly possessed by Grade 4 and Grade 8 students in TIMSS 2003: calculator, computer, study desk, and dictionary. As Table 4 shows, the correlation of this index with achievement in mathematics and science is quite stable for Populations 1 and 2. Table 5 features the relationship between the tendency for a country to group students according to their ability (intra-class coefficient) and the correlation educational resources/ achievement. The correlations in this table tell us that the more selective systems are also the less equitable at the primary level. However, the pattern is reversed at the secondary level. Here, the larger the differences in achievement are between schools, the weaker the relationship is between educational resources and achievement.

Contrary to what we found with the books at home measure, the intra-class correlation growth (increase) between Populations 1 and 2 seems congruent with the growth (decrease) in the correlation coefficients between educational resources and performance between the two populations. (For detailed figures, see Appendix Tables A4 and A5.) The correlation

*Table 4: Correlation between SES (Educational Resources) and Achievement—TIMSS 2003*

| | Population 1 | Population 2 |
|---|---|---|
| Mathematics (2003) | 0.27 | 0.23 |
| Science (2003) | 0.24 | 0.22 |

*Table 5: Correlation between (1) Intra-class Coefficient and (2) the SES (Educational Resources) and Achievement Correlation—TIMSS 2003*

| | Population 1 | Population 2 |
|---|---|---|
| Mathematics (2003) | 0.31 | -0.27 |
| Science (2003) | 0.57 | -0.17 |

coefficients between the two growths were respectively 0.19 and 0.32 for mathematics and science.

Does this result lead to the conclusion that selective systems are actually more equitable, in the sense that the differentiation intervening at the beginning of secondary education limits, or even reverses, the increasing influence of family resources on achievement? Or are there other factors affecting the SES index? A closer look at the results revealed that the correlation between SES and achievement for Population 2 was particularly low in the more industrialized countries, and tended to remain stable, or even to increase, in countries with low GDP, such as Cyprus, Lithuania, and Latvia. On removing these less industrialized countries from the analysis, we found that the correlation coefficients between the intra-class coefficient increase and the SES impact decreased to 0.53 for mathematics, and 0.62 for sciences.

This instability of the results according to the level of development of the country suggests a "ceiling effect" hypothesis. In the most industrialized countries, it appears that the educational resources index is not discriminating enough because most Grade 8 students do possess the four items at home. Also in industrialized countries, the low level of correlation between education resources and achievement in mathematics and science for Population 2 does not mean there is no link between SES and achievement, but rather that contextual variables prevent a sufficiently robust measure of this dimension and its link with achievement.

## Conclusion

Political interest in and demand for equity indicators, and the need to better understand the link between structural choices (variables that are managed politically) and equity and effectiveness reinforce the need for international surveys to gather information in these sensitive domains. In this respect, IEA's studies of achievement across two populations of students provide unique sources of data that allow us to compare equity at different levels of education in various education systems. The two studies from which we drew data for the analysis presented in this paper were the IEA Reading Literacy Study 1991 and TIMSS 2003.

Convergent results on the relationship between education structures and equity led us to investigate the hypothesis that the correlation between SES and student performance in reading, mathematics, and science would be stronger in systems with ability grouping than in those without ability grouping. At this stage, the data do not allow us to give firm support to the hypothesis because of the difficulty of finding a measure of students' socioeconomic background that is equally reliable across different levels of education and different assessment domains.

The analysis performed on data from the two IEA studies indicates that the number of books at home is not always a consistent SES proxy. Its interaction with gender in reading at the primary level suggests that this variable not only measures a quantity of goods at home (probably quite difficult to assess at Grade 4), but may also measure, mainly for girls, the value accorded to books at this age. While more coherent across gender and domains, the measure based on

educational resources at home is also not a relevant SES proxy because the international common items are not discriminating enough for industrialized countries.

Interaction between the SES variable with proficiency (in the case of "books at home") and ceiling effects (in the case of "educational resources") affect ability to build equity indicators based on IEA Reading Literacy and TIMSS data, even though these studies offer a unique opportunity to study cross-level effects. Further work on a composite index of socioeconomic background, including information on student status with regard to immigration and national-specific variables on the items possessed at home, is needed in order to build a stronger socioeconomic index, and to document the issue of the impact of education structures on equity of achievement.

This paper also suggests that a project as ambitious as the one announced here (i.e., an analysis of the equity of education systems in relation to their institutional settings) cannot be achieved through use of one single equity indicator. In addition to consideration of the methodological issues associated with building indicators, this paper emphasizes the need for a system of equity indicators that capture the complexity of education systems and the interaction between phenomena. The variety of the dimensions to be taken into account rests on the importance placed, especially within the political sphere, on the equity issue.

## Appendix

*Table A1: IEA Reading Literacy 1991*

| Countries | Correlation Books/ Achievement Pop. I | Intra-class coefficient Pop. I | Correlation Books/ Achievement Pop. II | Intra-class coefficient Pop. II | Difference correlation SES Achievement Pop. 2 – Pop. 1 (col. 3 - col. 1) | Difference intra-class coefficient Pop. 2 – Pop. 1 (col. 4 – col. 2) |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Belgium (Fr) | 0.24 | 0.16 | 0.32 | 0.42 | 0.08 | 0.26 |
| Canada (BC) | 0.17 | 0.16 | 0.19 | 0.18 | 0.02 | 0.02 |
| Switzerland | 0.22 | 0.10 | 0.30 | 0.49 | 0.08 | 0.39 |
| Cyprus | 0.14 | 0.12 | 0.27 | 0.13 | 0.13 | 0.01 |
| Germany (E) | 0.22 | 0.14 | 0.38 | 0.09 | 0.16 | -0.05 |
| Germany (W) | 0.25 | 0.13 | 0.47 | 0.50 | 0.22 | 0.37 |
| Denmark | 0.13 | 0.10 | 0.31 | 0.06 | 0.18 | -0.04 |
| Finland | 0.11 | 0.08 | 0.21 | 0.02 | 0.10 | -0.06 |
| France | 0.20 | 0.12 | 0.34 | 0.33 | 0.14 | 0.21 |
| Greece | 0.23 | 0.33 | 0.29 | 0.21 | 0.06 | -0.12 |
| Hong Kong SAR | 0.14 | 0.29 | 0.17 | 0.43 | 0.03 | 0.14 |
| Hungary | 0.30 | 0.21 | 0.41 | 0.24 | 0.11 | 0.03 |
| Iceland | 0.13 | 0.08 | 0.23 | 0.03 | 0.10 | -0.05 |
| Ireland | 0.24 | 0.15 | 0.32 | 0.47 | 0.08 | 0.32 |
| Italy | 0.19 | 0.32 | 0.29 | 0.27 | 0.10 | -0.05 |
| Netherlands | 0.21 | 0.13 | 0.31 | 0.56 | 0.10 | 0.43 |
| Norway | 0.15 | 0.05 | 0.28 | 0.04 | 0.13 | -0.01 |
| New Zealand | 0.31 | 0.18 | 0.37 | 0.42 | 0.06 | 0.24 |
| Portugal | 0.32 | 0.30 | 0.25 | 0.29 | -0.07 | -0.01 |
| Singapore | 0.26 | 0.21 | 0.32 | 0.56 | 0.06 | 0.35 |
| Slovenia | 0.22 | 0.10 | 0.30 | 0.11 | 0.08 | 0.01 |
| Sweden | 0.16 | 0.09 | 0.31 | 0.08 | 0.15 | -0.01 |
| United States | 0.22 | 0.21 | 0.32 | 0.43 | 0.10 | 0.22 |
| *Correlation col. 1 & 2* | | *0.43* | | | | |
| *Correlation col. 3 & 4* | | | | *0.31* | | |
| *Correlation col. 5 & 6* | | | | | | *0.04* |

*Table A2: TIMSS 2003, Mathematics*

| Countries | Correlation Books/ Achievement Pop. I | Intra-class coefficient Pop. I | Correlation Books/ Achievement Pop. II | Intra-class coefficient Pop. II | Difference correlation SES Achievement Pop. 2 – Pop. 1 (col. 3 - col. 1) | Difference intra-class coefficient Pop. 2 – Pop. 1 (col. 4 – col. 2) |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Australia | 0.24 | 0.25 | 0.24 | 0.49 | -0.01 | 0.24 |
| Belgium (Fl) | 0.22 | 0.16 | 0.25 | 0.63 | 0.03 | 0.48 |
| Canada (O) | 0.25 | 0.19 | 0.31 | 0.16 | 0.06 | -0.03 |
| Canada (Q) | 0.21 | 0.15 | 0.25 | 0.41 | 0.04 | 0.26 |
| Cyprus | 0.16 | 0.10 | 0.27 | 0.06 | 0.11 | -0.05 |
| England | 0.32 | 0.24 | 0.37 | 0.55 | 0.05 | 0.31 |
| Hong Kong SAR | 0.15 | 0.25 | 0.20 | 0.58 | 0.06 | 0.32 |
| Hungary | 0.34 | 0.24 | 0.44 | 0.34 | 0.10 | 0.10 |
| Italy | 0.10 | 0.32 | 0.30 | 0.28 | 0.20 | -0.04 |
| Japan | 0.26 | 0.06 | 0.28 | 0.14 | 0.02 | 0.08 |
| Lithuania | 0.27 | 0.23 | 0.34 | 0.20 | 0.07 | -0.03 |
| Latvia | 0.20 | 0.23 | 0.25 | 0.24 | 0.05 | 0.01 |
| Netherlands | 0.30 | 0.16 | 0.36 | 0.71 | 0.06 | 0.56 |
| Norway | 0.23 | 0.10 | 0.29 | 0.11 | 0.06 | 0.01 |
| New Zealand | 0.32 | 0.34 | 0.34 | 0.45 | 0.02 | 0.12 |
| Scotland | 0.25 | 0.18 | 0.41 | 0.57 | 0.16 | 0.39 |
| Singapore | 0.34 | 0.56 | 0.34 | 0.39 | 0.00 | -0.17 |
| Slovenia | 0.18 | 0.12 | 0.28 | 0.12 | 0.10 | 0.00 |
| United States | 0.32 | 0.29 | 0.38 | 0.40 | 0.07 | 0.11 |
| *Correlation col. 1 & 2* | | *0.33* | | | | |
| *Correlation col. 3 & 4* | | | | *0.15* | | |
| *Correlation col. 5 & 6* | | | | | | *-0.10* |

*Table A3: TIMSS 2003, Science*

| Countries | Correlation Books/ Achievement Pop. I | Intra-class coefficient Pop. I | Correlation Books/ Achievement Pop. II | Intra-class coefficient Pop. II | Difference correlation SES Achievement Pop. 2 – Pop. 1 (col. 3 - col. 1) | Difference intra-class coefficient Pop. 2 – Pop. 1 (col. 4 – col. 2) |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Australia | 0.28 | 0.25 | 0.33 | 0.49 | 0.06 | 0.24 |
| Belgium (Fl) | 0.22 | 0.16 | 0.29 | 0.63 | 0.07 | 0.48 |
| Canada (O) | 0.27 | 0.19 | 0.32 | 0.16 | 0.05 | -0.03 |
| Canada (Q) | 0.18 | 0.15 | 0.28 | 0.41 | 0.10 | 0.26 |
| Cyprus | 0.13 | 0.10 | 0.27 | 0.06 | 0.13 | -0.05 |
| England | 0.33 | 0.24 | 0.41 | 0.55 | 0.08 | 0.31 |
| Hong Kong SAR | 0.14 | 0.25 | 0.20 | 0.58 | 0.06 | 0.32 |
| Hungary | 0.30 | 0.24 | 0.40 | 0.34 | 0.10 | 0.10 |
| Italy | 0.12 | 0.32 | 0.27 | 0.28 | 0.15 | -0.04 |
| Japan | 0.22 | 0.06 | 0.28 | 0.14 | 0.06 | 0.08 |
| Lithuania | 0.24 | 0.23 | 0.28 | 0.20 | 0.04 | -0.03 |
| Latvia | 0.21 | 0.23 | 0.23 | 0.24 | 0.02 | 0.01 |
| Netherlands | 0.28 | 0.16 | 0.40 | 0.71 | 0.11 | 0.56 |
| Norway | 0.21 | 0.10 | 0.29 | 0.11 | 0.08 | 0.01 |
| New Zealand | 0.29 | 0.34 | 0.40 | 0.45 | 0.12 | 0.12 |
| Scotland | 0.25 | 0.18 | 0.47 | 0.57 | 0.23 | 0.39 |
| Singapore | 0.36 | 0.56 | 0.39 | 0.39 | 0.03 | -0.17 |
| Slovenia | 0.18 | 0.12 | 0.28 | 0.12 | 0.10 | 0.00 |
| United States | 0.31 | 0.29 | 0.42 | 0.40 | 0.11 | 0.11 |
| *Correlation col. 1 & 2* | | *0.48* | | | | |
| *Correlation col. 3 & 4* | | | | *0.45* | | |
| *Correlation col. 5 & 6* | | | | | | *0.29* |

*Table A4: TIMSS 2003, Mathematics*

| Countries | Correlation Educational Resources/ Achievement Pop. I | Intra-class coefficient Pop. I | Correlation Educational Resources/ Achievement Pop. II | Intra-class coefficient Pop. II | Difference correlation SES Achievement Pop. 2 – Pop. 1 (col. 3 - col. 1) | Difference Intra-class coefficient Pop. 2 – Pop. 1 (col. 4 – col. 2) |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Australia | 0.28 | 0.25 | 0.16 | 0.49 | -0.11 | 0.24 |
| Belgium (Fl) | 0.14 | 0.16 | 0.26 | 0.63 | 0.12 | 0.48 |
| Canada (O) | 0.27 | 0.19 | 0.18 | 0.16 | -0.09 | -0.03 |
| Canada (Q) | 0.25 | 0.15 | 0.13 | 0.41 | -0.12 | 0.26 |
| Cyprus | 0.29 | 0.10 | 0.37 | 0.06 | 0.08 | -0.05 |
| England | 0.27 | 0.24 | 0.23 | 0.55 | -0.04 | 0.31 |
| Hong Kong SAR | 0.12 | 0.25 | 0.14 | 0.58 | 0.03 | 0.32 |
| Hungary | 0.36 | 0.24 | 0.37 | 0.34 | 0.01 | 0.10 |
| Italy | 0.18 | 0.32 | 0.21 | 0.28 | 0.04 | -0.04 |
| Japan | 0.22 | 0.06 | 0.19 | 0.14 | -0.02 | 0.08 |
| Lithuania | 0.30 | 0.23 | 0.30 | 0.20 | 0.00 | -0.03 |
| Latvia | 0.22 | 0.23 | 0.21 | 0.24 | 0.00 | 0.01 |
| Netherlands | 0.22 | 0.16 | 0.16 | 0.71 | -0.05 | 0.56 |
| Norway | 0.30 | 0.10 | 0.17 | 0.11 | -0.14 | 0.01 |
| New Zealand | 0.34 | 0.34 | 0.22 | 0.45 | -0.12 | 0.12 |
| Scotland | 0.29 | 0.18 | 0.26 | 0.57 | -0.03 | 0.39 |
| Singapore | 0.38 | 0.56 | 0.25 | 0.39 | -0.12 | -0.17 |
| Slovenia | 0.34 | 0.12 | 0.25 | 0.12 | -0.09 | 0.00 |
| United States | 0.34 | 0.29 | 0.23 | 0.40 | -0.11 | 0.11 |
| *Correlation col. 1 & 2* | | *0.31* | | | | |
| *Correlation col. 3 & 4* | | | | *-0.27* | | |
| *Correlation col. 5 & 6* | | | | | | *0.19* |

*Table A5: TIMSS 2003, Science*

| Countries | Correlation Educational Resources/ Achievement Pop. I | Intra-class coefficient Pop. I | Correlation Educational Resources/ Achievement Pop. II | Intra-class coefficient Pop. II | Difference correlation SES Achievement Pop. 2 – Pop. 1 (col. 3 - col. 1) | Difference Intra-class coefficient Pop. 2 – Pop. 1 (col. 4 – col. 2) |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Australia | 0.29 | 0.25 | 0.17 | 0.49 | -0.13 | 0.24 |
| Belgium (Fl) | 0.14 | 0.16 | 0.26 | 0.63 | 0.12 | 0.48 |
| Canada (O) | 0.26 | 0.19 | 0.12 | 0.16 | -0.15 | -0.03 |
| Canada (Q) | 0.22 | 0.15 | 0.14 | 0.41 | -0.08 | 0.26 |
| Cyprus | 0.23 | 0.10 | 0.31 | 0.06 | 0.09 | -0.05 |
| England | 0.22 | 0.24 | 0.23 | 0.55 | 0.01 | 0.31 |
| Hong Kong SAR | 0.09 | 0.25 | 0.11 | 0.58 | 0.02 | 0.32 |
| Hungary | 0.33 | 0.24 | 0.32 | 0.34 | -0.01 | 0.10 |
| Italy | 0.19 | 0.32 | 0.19 | 0.28 | 0.00 | -0.04 |
| Japan | 0.18 | 0.06 | 0.18 | 0.14 | 0.01 | 0.08 |
| Lithuania | 0.19 | 0.23 | 0.20 | 0.20 | 0.02 | -0.03 |
| Latvia | 0.24 | 0.23 | 0.25 | 0.24 | 0.01 | 0.01 |
| Netherlands | 0.14 | 0.16 | 0.15 | 0.71 | 0.01 | 0.56 |
| Norway | 0.22 | 0.10 | 0.20 | 0.11 | -0.02 | 0.01 |
| New Zealand | 0.36 | 0.34 | 0.26 | 0.45 | -0.10 | 0.12 |
| Scotland | 0.25 | 0.18 | 0.25 | 0.57 | 0.00 | 0.39 |
| Singapore | 0.40 | 0.56 | 0.27 | 0.39 | -0.13 | -0.17 |
| Slovenia | 0.27 | 0.12 | 0.25 | 0.12 | -0.02 | 0.00 |
| United States | 0.32 | 0.29 | 0.23 | 0.40 | -0.08 | 0.11 |
| *Correlation col. 1 & 2* | | *0.57* | | | | |
| *Correlation col. 3 & 4* | | | | *-0.17* | | |
| *Correlation col. 5 & 6* | | | | | | *0.32* |

*Table A6: Correlation between SES (Books) and Achievement, by Gender—TIMSS 2003, Mathematics*

| Countries | Boys | Girls | Difference | Boys | Girls | Difference |
|---|---|---|---|---|---|---|
| Australia | 0.27 | 0.29 | 0.02 | 0.19 | 0.15 | -0.03 |
| Belgium (Fl) | 0.18 | 0.11 | -0.08 | 0.25 | 0.28 | 0.03 |
| Canada (O) | 0.24 | 0.30 | 0.05 | 0.19 | 0.18 | -0.01 |
| Canada (Q) | 0.27 | 0.24 | -0.03 | 0.14 | 0.12 | -0.02 |
| Cyprus | 0.29 | 0.29 | 0.00 | 0.37 | 0.35 | -0.02 |
| England | 0.30 | 0.25 | -0.05 | 0.22 | 0.23 | 0.01 |
| Hong Kong SAR | 0.10 | 0.13 | 0.03 | 0.13 | 0.15 | 0.02 |
| Hungary | 0.37 | 0.34 | -0.03 | 0.39 | 0.35 | -0.04 |
| Italy | 0.16 | 0.19 | 0.03 | 0.22 | 0.21 | -0.01 |
| Japan | 0.19 | 0.24 | 0.05 | 0.19 | 0.20 | 0.01 |
| Lithuania | 0.31 | 0.28 | -0.02 | 0.32 | 0.28 | -0.04 |
| Latvia | 0.24 | 0.20 | -0.04 | 0.24 | 0.20 | -0.04 |
| Netherlands | 0.23 | 0.21 | -0.02 | 0.16 | 0.17 | 0.01 |
| Norway | 0.30 | 0.31 | 0.00 | 0.13 | 0.19 | 0.06 |
| New Zealand | 0.34 | 0.35 | 0.00 | 0.22 | 0.22 | 0.00 |
| Scotland | 0.30 | 0.30 | 0.01 | 0.26 | 0.26 | 0.00 |
| Singapore | 0.37 | 0.38 | 0.01 | 0.22 | 0.27 | 0.04 |
| Slovenia | 0.36 | 0.32 | -0.04 | 0.23 | 0.28 | 0.05 |
| United States | 0.33 | 0.36 | 0.03 | 0.23 | 0.24 | 0.01 |

*Table A7: Correlation between SES (Books) and Achievement, by Gender—TIMSS 2003, Science*

| Countries | Boys | Girls | Difference | Boys | Girls | Difference |
|---|---|---|---|---|---|---|
| Australia | 0.31 | 0.25 | **-0.06** | 0.38 | 0.29 | **-0.08** |
| Belgium (Fl) | 0.20 | 0.24 | 0.04 | 0.32 | 0.36 | 0.03 |
| Canada (O) | 0.28 | 0.27 | -0.01 | 0.27 | 0.29 | 0.02 |
| Canada (Q) | 0.22 | 0.16 | **-0.06** | 0.42 | 0.40 | -0.03 |
| Cyprus | 0.14 | 0.13 | -0.01 | 0.27 | 0.26 | -0.01 |
| England | 0.35 | 0.32 | -0.03 | 0.52 | 0.45 | **-0.07** |
| Hong Kong SAR | 0.13 | 0.14 | 0.01 | 0.23 | 0.17 | -0.06 |
| Hungary | 0.34 | 0.27 | **-0.08** | 0.42 | 0.42 | 0.00 |
| Italy | 0.13 | 0.11 | -0.02 | 0.29 | 0.26 | -0.03 |
| Japan | 0.20 | 0.23 | 0.03 | 0.34 | 0.22 | **-0.12** |
| Lithuania | 0.24 | 0.23 | -0.01 | 0.31 | 0.24 | **-0.07** |
| Latvia | 0.19 | 0.22 | 0.03 | 0.25 | 0.21 | -0.05 |
| Netherlands | 0.30 | 0.28 | -0.02 | 0.40 | 0.40 | 0.00 |
| Norway | 0.26 | 0.17 | -0.09 | 0.29 | 0.30 | 0.01 |
| New Zealand | 0.32 | 0.27 | -0.05 | 0.40 | 0.41 | 0.01 |
| Scotland | 0.23 | 0.28 | 0.05 | 0.31 | 0.29 | -0.02 |
| Singapore | 0.37 | 0.37 | 0.01 | 0.41 | 0.38 | -0.03 |
| Slovenia | 0.14 | 0.21 | **0.08** | 0.28 | 0.28 | 0.00 |
| United States | 0.33 | 0.31 | -0.02 | 0.45 | 0.41 | -0.05 |

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