Measuring Students' Family Background

in Large-scale Education Studies

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Abstract

The results of various education studies have shown that the family background of students, often measured in terms of social status of parents or legal guardians, is correlated to the achievement of students in school. This paper focuses on the measurement of students' family background within large-scale education studies.

The operationalization of family background varies between different education studies. The intent of this paper is to provide a summary and evaluation of the different ways and concepts of measuring students' family background. It will focus on IEA's PIRLS 2006 and TIMSS 2007 as well as on OECD PISA 2006 data.

In addition to summarizing the different approaches of measuring family background, the paper attempts to evaluate the approaches with regard to a set of criteria, i.e. the amount of missing data, the reliability of scales, and the association of the indicators and measures of family background with students' achievement.

The different approaches of measuring family background in large-scale education studies will be evaluated and compared. The paper will try to identify best practice and to provide suggestions on how to improve measuring family background for future large-scale education studies.

1 Introduction

The results from various education studies have shown that the family background of students in schools is (sometimes highly) correlated to their achievement in school (see e.g., Mullis, Martin, Kennedy, & Foy 2007: 105ff.; OECD 2007: 181ff.; Mullis, Martin & Foy 2008: 155ff.). The influence of family background and socio-economic status in particular on achievement has been of great interest since a long time. One of the most prominent studies of background characteristics and their relationship with educational outcomes has been published by James Coleman and his colleagues under the title "Equality of Educational Opportunity" in 1966, better known as the "Coleman Report" (Coleman et al., 1966). The authors of this book conduct a comprehensive study on the background characteristics of schools and students that influence the outcomes of education. The results published in the "Coleman Report" still today raise discussions among social scientists.

This paper builds upon work on a bigger research project financed by the National Council for Education Statistics (NCES). The NCES project aims to provide an overview of the measurement of family background until presence, to analyze the relationships of family background measures with educational outcomes and to suggest ways to improve data collection with regard to family background. The operationalization of family background varies a lot between different education studies. For example, while TIMSS mostly reports on single indicators, PIRLS and PISA derive scales (e.g., the "Index of Home Educational Resources" (PIRLS) and the "Index of Economic, Social and Cultural Status" (PISA)). The research project analyzes the different approaches and concepts that are used to measure family background of students.

In addition to summarizing the different approaches of measuring family background used in the large-scale education studies PIRLS, PISA, and TIMSS, the NCES project attempts to evaluate the effectiveness of those approaches with regard to several criteria in order to identify the best (i.e., most desirable) practice (see May, 2002: 126). It aims at providing estimates and numbers about the quality of the measure for family background

in terms of missing data, reliability, relationship with achievement and capability to explain variance in achievement. Furthermore, the different approaches of measuring family background in large-scale education studies will be evaluated and compared.

This paper provides a summary of the first findings from the NCES project. As the NCES project is much broader in scope, this paper will concentrate on analysis of family background measures on highly aggregated level, i.e. findings on study level and with regard to components of family background. Furthermore, areas for further research needs will be identified.

2 Theoretical Background

Family background has been and remains an important variable to explain variance in students' academic achievement (see White, Reynolds, Thomas & Gitzlaff 1993; Sirin 2005). The question of how students' family background influences achievement is often seen as an issue of equality, therefore it has been on the political agenda for decades and believed to be of high importance. For example, the "achievement gap" discussion in the US, initiated by the Coleman Report in the 1960's, has been and continues to be a topic attracting high attention (see Lee 2002: 3f.).

Mainly three concepts for describing differences in social relations have evolved throughout the decades. Social class and social stratification were the first concepts used by social scientists to group members of a society emphasizing a clear division of social groups and also the consciousness of belonging to a certain group (see Bond 1981). Moving away from group memberships, the notion of socio-economic status focuses instead on the relative position of an individual or family within a hierarchical social structure, based on their access to, or control over wealth, prestige, and power (Mueller & Parcel, 1981). Finally, conceptualizations of family background started making use of theories of social and cultural capital, stressing the importance of connectedness and communication opportunities within society as well as cultural habits and attainments that can be used to identify differences in family background (see Bourdieu 1986; Coleman 1988).

2.1 Indices, Scales, and other Combinations of Components

There is no standard for operationalizing the above mentioned concepts that is agreed upon in social science in general, neither in educational research in particular. As a result, there are a number of components and indicators that are used in different combinations either separately or to form scales, yet again different from study to study. Nevertheless, there are certain components of family background that are used more often and that are seen as more important than others.

Socio-Economic Status (SES)

According to Merola (2005), nowadays measures of family SES are usually derived from parents' educational attainment, occupational status, and financial resources. However not all studies use all three components. For example, the NAEP studies use only educational attainment and financial resources. Problems with using only two of the three components were, amongst others, reported by Freidlin (1995).

To compare the relative positions of individuals within a given society according to their occupation one of the following three approaches are used: prestige ratings, sociologically derived class measures, and socioeconomic status scores. The most prominent examples are the Standard International Occupational Prestige Scale (SIOPS) (Treiman, 1977), the EGP class scheme (Erikson, Goldthorpe & Portocarero, 1979),

which is an occupational class scheme, and the International Socio-Economic Index of Occupational Status (ISEI) (Ganzeboom, De Graaf & Treiman, 1992).

Cultural Capital

To acquire two of the three different forms of cultural capital time needs to be invested by the individual (Bourdieu, 1986). In its institutionalized state cultural capital can exist as academic qualifications. In its embodied state cultural capital can be seen as the ability to understand and apply cultural techniques, for example reading. Following this line of thinking and to mention one example, the authors of the PIRLS 2006 assessment framework delineate the necessity of collecting data on the literacy activities of parents with their children that will foster positive attitudes towards reading (Mullis, Kennedy, Martin & Sainsbury, 2006). Items that measure the frequencies of these early literacy activities with their children at home were used to derive a scale called the "Index of Early Home Literacy Activities" (EHLA) (Martin, Mullis & Kennedy, 2007, p. 201). Another indicator of the embodied state of cultural capital is the familiarity with the dominant culture and language. Usually, indicators like immigration background and language spoken at home are used as a proxy. The third form of cultural capital, the objectified state, is often operationalized with a list of cultural possessions. PISA 2006 for example summarizes three possessions (classic literature, books of poetry, and works of art) to an index called "Cultural Possessions" (CULTPOSS) (OECD, 2009, p. 316). Education certificates are another indicator of the objectified cultural capital. Hence, parents' formal school and vocational education are included frequently in surveys.

Social Capital

Concepts usually include family size, family structure and occupational status of parents with regard to time available for building and maintaining social capital (i.e., connections) within and outside family (see e.g., Baumert & Schümer, 2001).

Combinations

In PISA an index was derived from various indicators that is ought to represent economic, social and also cultural status (OECD, 2009).

2.2 Issues with Indicators of Family Background

Family background is only one aspect of interest in large scale assessments. There is only limited time to collect data with instruments of limited length and a limited number of questions. Collecting data need to be focused on the most important characteristics with a limited number of items which therefore need to be very precise. As Hauser (1994, p. 1541) says, the burden of data to be collected should be kept in bounds, so that the focus should be "…on characteristics that will be relatively easy to measure, that can be measured for every child in the survey, and that will probably not vary greatly over the short term".

Indicators frequently used to describe family wealth in terms of financial resources are family income, parents' occupation, and certain home possessions. All have certain downsides. Income is volatile and changing in time (Hauser, 1994: 1543) and also has higher item non-response than other indicators of family background, because some parents regard income as sensitive information that they are not willing to provide, or students simply do not know the income of their parents (Entwistle & Astone, 1994: 1525f.). Occupation usually involves an extensive coding task. Finally, the value of home possessions is not universal across all countries due to

cultural diversity and economic differences (Yang & Gustafsson, 2004).

Other indicators of cultural capital also bear the risk of being not comparable across different countries. For example, the value of certain educational attainments could differ vastly according to the number of their owners in society. Whereas completing secondary school is usually achieved by a majority in industrialized countries, the proportion of people is comparatively lower in developing countries, resulting in different appreciations for the same formal education.

With regard to the issue of how to best collect data on family background in large scale education assessments, the question of who to collect the information from - students or their parents or guardians - needs to be addressed. As research shows (Baratz-Snowden, Pollack & Rock, 1988) the validity and reliability of information about the family provided by students depends on the age of students. Whereas students in elementary school tend not to know or not to answer questions related to parental characteristics, e.g. education, data provided by students at age 14 and 15 is about as reliable as given by their parents (e.g., Hauser, 1994; Adams & Wu, 2002).

3 Methodology

3.1 Research Question

As the previous chapters showed, there are a number of (problematic) issues regarding the use and application of measures of family background: diverse use of components of family background, missing data, reliability of information provided by respondents, operationalization of latent constructs, study specific definitions of the same latent constructs and the use of different constructs in different studies reducing comparability across studies, and cross-cultural validity.

All these problems with measuring family background lead to the following research questions for this paper:

1. Which measures of family background provide the highest quality data in terms of missing data and reliability?
2. Which of the measures of family background have substantial association with achievement across countries and which of them explain the highest amount of variance in achievement?
3. Which family background measures seem to be the most appropriate to account for students' achievement with regard to different content domains, target populations, missingness, reliability, and validity in future large-scale education studies?

3.2 Data

The data used in the analyses are taken from the IEA Trends in Mathematics and Science Study (TIMSS) in 2007, the IEA Progress in Reading Literacy Study (PIRLS) in 2006 and the OECD Programme for International Student Assessment (PISA) in 2006.[1] The analysis will focus on indicators reported in the PIRLS 2006 (Mullis, et al. 2007), PISA 2006 (OECD 2007) and TIMSS 2007 (Mullis et al. 2008) international reports. This will include both the single indicators from the survey instruments as well as the derived indices available for

[1] Tables A.1 to A.7 in the appendix list all variables, scales and other derived variables of family background used in this analysis.

PIRLS and PISA. Basically PIRLS indices are derived by summing up separate items in the same background domain according to a rule defining the combinations of responses for the different items or calculating their average responses and defining its range for the separate categories. The scales were constructed in the very same manner for each country (for more details see Martin et al., 2007). PISA indices were constructed estimating item parameters for each set of items included in the index. These item parameters were anchored and each country was scaled separately. The Index of Economic, Social and Cultural Status was created using three previously created indices (for more information on PISA indices see OECD, 2009).

The analysis will include two comparisons: one between PIRLS 2006 and TIMSS 2007 (4^{th} grade) data and one between PISA 2006 and TIMSS 2007 (8^{th} grade) data. This way, students from similar age groups are compared.[2] For each one of the comparison pairs (PIRLS 2006 and TIMSS 2007 4^{th} grade; PISA 2006 and TIMSS 2007 8^{th} grade) only those countries that participate in both studies will be selected.[3] Unless explicitly stated differently, this paper reports with regard to those sets of countries.

3.3 Analysis Components

Missingness

The usual and easiest solution to deal with missing data is to exclude records that consist of missing values for any variable included in the analysis (Alison, 2002). But this also decreases the effective sample size. As McKnight, McKnight, Sidani & Figueredo (2007) argue, the biggest problem missing data are causing is related with its influence on the results of a study. Additionally, the decreased sample size due to missing data could result in loss of representativeness and missing data could lead to biased estimates and wrong statistical conclusions, reliability and validity of the results (McKnight et al., 2007). In this paper, the amount of missing data per family background variable, scale or index composed from separate family background indicators will be analyzed and compared across the studies of interest.

Reliability of Scales

According to Cronbach (1960), reliability provides information "about the consistency of a person's scores on a series of measurement" (Cronbach, 1960, p. 126). Cronbach's alpha, widely used as a coefficient of reliability, is close to the classical definition of reliability – "…the proportion of variance in a scale that is attributable to the true score of the latent variable" (DeVellis, 2003, p. 47). In this study the reliability of the derived scales of family background in PIRLS 2006 and PISA 2006 will be compared using Cronbach's alpha.[4]

Association with Achievement

Information about family background is important for the analysis of contextual factors (resources and activities) that can foster students' achievement (Mullis et al., 2006). The current study aims to determine the strength of the association of background variables (as separate components and derived variables) with achievement. This will be done by determining correlation coefficients where appropriate, the variance in

[2] Whereas PIRLS and TIMSS use a grade based student sample, the student sample in PISA is age based. TIMSS 4^{th} grade and PIRLS report on the same population. Students in the PISA 2006 sample are on average 15.8 years old and a majority attend grade 10 already. TIMSS 2007 grade 8 students are per definition attending grade 8. They are on average 14.3 years old. Although both studies report on secondary school students, this difference needs to be kept in mind when comparing the two studies.

[3] Table A.8 in the appendix provides a list of those countries.

[4] TIMSS 2007 does not derive any scale from variables of family background

achievement explained by indicators of family background in a regression model, and the proportion of countries for which the regression model of the association of the family background indicator with achievement is significant. The association of the family background variables with achievement will be investigated with regard to the overall reading achievement for PIRLS 2006, the mathematics and science domains for TIMSS 2007, and reading, mathematics and science achievement for PISA 2006.

4 Findings

The items used in the two pairs of studies - PIRLS 2006 and TIMSS 2007 grade 4 as well as TIMSS 2007 grade 8 and PISA 2006 - cover five aspects of family background: home possessions, immigration status of students and their parents, language use at home, parents' education, and parents' employment situation. Each aspect will be discussed with regard to the outcomes of the analysis mentioned before. To report outcomes (missingness, reliability, and association with achievement), the median of the item, scale or index across the selected countries will be used. The distribution across countries will be compared using the interquartile range. The derived indices/scales from PIRLS and PISA will be analyzed separately from the single measures of family background at the end of this section.

4.1 Home possessions

Information on home possessions is provided by almost all students. Throughout both age groups, the missing rate is very low. There is one outstanding item with regard to association with achievement: The number of books in the home yields the highest median correlation with achievement in all three subject domains (reading, math, and science) and all four studies. In both PISA and TIMSS grade 8 the median correlations with achievement is 0.33 in math and even higher in science (0.34 and 0.35) and as a predictor in a simple linear regression model the median of the explained variance is 11% in math and 12% in science. In PIRLS, the correlation is 0.30 with 9% explained variance. PIRLS also collects information from parents about books in the student's home. This item as well as an additional item about the number of children's books in the home yields similar results as the information on books in the home provided by students (median correlation 0.30 and 0.29, 9% and 8% explained variance). In TIMSS grade 4 the median correlation with students' math achievement (0.25) and science achievement (0.29) as well as the median of the explained variance (0.06 and 0.09 respectively) is a bit lower, but also in TIMSS grade 4 data the number of books at home yield the highest association with achievement amongst all single indicators.

Table 4.1 shows an example of the results for the above mentioned items in the PIRLS 2006 data. The full tables including all results from all four studies and from all five domains are provided in the appendix (tables A.9 to A.15).

Table 4.1: Example table for missing data, correlation and regression results for PIRLS 2006

			Subject	Not Subject related				Reading				
Study	**Respondent**	**Item**	**Item Content**	**M1**	**M2**	**M3**	**M4**	**C1**	**C2**	**R1**	**R2**	**R3**
PIRLS	Student	ASBGBOOK	Books in the home	-	-	2,7	7,1	0,30	0,10	0,09	0,06	25 / 25
PIRLS	Parents	ASBHBOOK	Books in the home	6,1	13,4	-	-	0,29	0,06	0,08	0,04	24 / 24
PIRLS	Parents	ASBHCHBK	Children's books in the home	5,9	13,4	-	-	0,30	0,10	0,09	0,06	24 / 24

M1 = Median % of missing data including unit-non-response
M2 = Interquartile range of % of missing data including unit-non-response
M3 = Median % of missing data not including unit-non-response
M4 = Interquartile range of % of missing data not including unit-non-response
C1 = Median Pearson correlation coefficient
C2 = Interquartile range of Pearson correlation coefficient
R1 = Median of explained variance in simple linear regression model
R2 = Interquartile range of explained variance in simple linear regression model
R3 = Proportion of countries with significant relationship in simple linear regression model
- = Analysis type not applicable

The possession of student's own books is the second best single indicator in PIRLS with a median correlation of 0.21 with reading achievement. The median of the explained variance in a simple linear regression model is 4%. There is no item amongst the TIMSS grade 4 home possession items similarly outstanding.

Within the older age group (TIMSS grade 8 and PISA) possessing a computer has some explanatory power in PISA, in TIMSS grade 8 it has almost none (6% and 5% in PISA for math and science achievement and 3% and 2% correspondingly in TIMSS). In PISA possessing classical literature has a similar strength as possessing a computer in all three subject domains (7%, 5%, and 6% for reading, math and science achievement). This possession is not covered in TIMSS grade 8.

4.2 Immigration status

Immigration status is operationalized in the studies in focus including three aspects: the immigration status of the parents, the immigration status of the student, and the age the student immigrated (the latter information is not accessed in PIRLS).

The amount of missing values for the variables related with the immigration status is in general quite low for all three studies. The students' age of immigration reveals higher missing rates than the information on if either family member (mother, father and student) was born in the country of test. Whereas in TIMSS 8th grade has 3,7% of missing data, PISA has 7,7% of missing data for information about the students' age of immigration. This might be due to the different item formats. PISA requires students to enter a number, TIMSS uses a closed item format with three categories.

In general, all variables related with immigration status of the students and their parents show only weak association with all subject domains. Concerning the younger age group, no indicator in PIRLS shows reasonable association with achievement (max. 1% explained variance). The regression model with the combined parents' immigration status is not even significant for the majority of the PIRLS countries in focus. In TIMSS 4th grade, however, parent's immigration status accounts for 4% of variance in science achievement, and the students' immigration status explains 5% of the variance in both science and math achievement.

It is interesting though, that this variable shows higher association in TIMSS grade 4, but not in TIMSS grade 8 data. In the older age group almost no variance is explained by either of the indicators of immigration status (max. 1%). In PISA, about half of the countries do not show a significant relation, in TIMSS 8th grade only

slightly more countries do.

4.3 Language use at home

Information on the language use at home provided by students has a low missing rate. Only in PIRLS 2006 the median missing rate is a bit higher with 5.2%. PIRLS 2006 is the only study asking parents directly in addition to students about the language they speak at home. The median amount of missing data here is already quite substantive (14.9% for language use of the father, 13.5% for the language use of the mother). The information on the language of children's books in the home provided by parents is somewhat more complete with a median of 7.6% of missing data. First more in-depth analysis suggest that the high amount of missing data provided by parents compared to data provided by students is due to parents' non-participation in the survey. Another reason might be the simple fact that several students live together with only one adult (parent, guardian or the like).

Analysis shows that in PIRLS there is almost no association between language of children's books and students' reading achievement (median explained variance ~0%). But for both, PIRLS and TIMSS 4th grade data, there is a weak correlation of the language spoken at home with students' achievement (0.09 for reading achievement in PIRLS, 0.13 and 0.18 for math and science achievement in TIMSS 4th grade), although the amount of variance explained is quite low with 3% for TIMSS science achievement at maximum.

In the older group, language use at home is operationalized differently in PISA and TIMSS 8th grade. TIMSS asks students to report on the frequency of the language of test at home using four categories ('always', 'almost always', 'sometimes' and 'never'). PISA simply asks if the most frequent language used at home is the language the test was taken. In both studies the items do not explain a substantive amount of variance (max. 1%). However, a weak correlation exists in the TIMSS data with 0.08 for math and 0.10 for science achievement.

4.4 Parents' education

In the younger age group, students have not been asked to provide information about parents' education. Thus, TIMSS 4th grade data does not contain information on parents' education. In PIRLS, this information was collected using the home questionnaire completed by parents.

In general, the median amount of missingness is much higher in the data obtained by the parents (applicable for PISA and PIRLS only) - 10% or higher, with highest values for the father's education in PIRLS and mother's education in PISA. The amount of missing data for student information on parents' education is comparably low in both TIMSS 8th grade and PISA data.

With regard to association with achievement, the variables on parental education show similar patterns across the studies, age groups and instruments. The median correlation coefficient between mothers' and fathers' education in PISA as obtained by students varies between 0.20 and 0.26 with math achievement showing the highest and reading achievement the lowest correlation. The median correlation for variables obtained by the parents is slightly higher (between 0.21 and 0.29), but the median amount of explained variance in achievement does not differ much between the sources of information (parents or students) – between 4% and 8%. In PIRLS the median correlation coefficient between parental education variables and reading achievement varies between 0.29 and 0.31. The amount of explained variance in reading achievement is 9% for all variables.

In general, the information provided by the parents (PISA only) again tends to show stronger correlation compared to the student data. The median correlation in TIMSS 8th grade between parental education (provided by students) and math and science achievement tends to be slightly stronger compared to PISA, varying between 0.28 and 0.30 for math and 0.27 and 0.30 for science achievement in TIMSS compared to 0.24 to 0.26 for math and 0.23 and 0.24 for science achievement in PISA. This also applies to the explained variance with 8% to 9% for math and 7% to 9% for science in TIMSS compared to 6% to 7% for math and 5% to 6% in science achievement in PISA.

4.5 Parents' occupation

Questions about the financial well-being of the student's family were administered in PIRLS and PISA. Comparisons between these two studies need to take into account that they administered different age groups. Nevertheless, both collected data from parents directly which might put this constraint into perspective. But then again, administering a questionnaire to parents was a national option in PISA that was only chosen by seven countries out of the 25 countries common with TIMSS grade 8. In addition to the data from parents, PISA also asked the students to provide information about the occupation of their parents. In PISA all information on occupation is transferred to the International Socio-Economic Index of Occupational Status (ISEI) (see 2.1).

In relative terms, in PISA data from students about their parent's occupation show similar patterns with regard to missingness and association with achievement as the same information provided by the parents themselves. In absolute values, information provided by students on the highest parental occupation correlates slightly higher with achievement (0.29 to 0.31 for the three subject domains of the students' data and 0.26 to 0.29 for the parents' data) and explains slightly more variance of achievement than information from parents about their occupation (7% to 8% for students' data and 8% to 10% for parents' data). Furthermore, median missing rates are somewhat higher for data from parents. But yet again, both data consist of the same pattern. Information about the mother's job coded as ISEI is missing for twice as much students as information about the father's job. The combination of both parents' individual occupation is coded as the highest ISEI within the family and provides the highest amount of valid data. The high amount of missing data for the individual occupations is to some extend due to the fact that people who do not have a regular occupation are not included and thus coded as missing data. This affects e.g., apprentices, university students, unemployed people, housewives and retirees. In general, associations with achievement are somewhat high throughout all variables on occupation and income in PISA. Median correlation varies between 0.22 and 0.31 and median explained variance between 5-10%. This includes the items about parents' occupation as well as the item on household income.

Missing rates for data on occupation and financial well-being in PIRLS are also moderate with median missing rates ranging from 7-15%, the lowest rate achieved with the self-reported financial well-off of the family (7.2%). The highest median amount of missing data comes with the information on mother's and father's occupation (14.8% and 14.2%). Correlation and regression analysis do not apply because the information on occupation is provided at nominal scale level.

4.6 Derived scales and indices

From the three studies of interests, only PIRLS and PISA derive scales and indices. However, since PIRLS and

PISA have different age populations and different sets of selected countries were chosen for this paper, direct comparisons should not be made. Therefore, the scales and indices from two studies are analyzed separately.

The Index of Home Educational Resources (HER) in PIRLS has a median amount of 6.6% missing data. The median reliability (Cronbach's alpha) of the index across all countries is 0.62.[5] The index shows moderate median correlation with the achievement (0.26) across the countries and a moderate amount of explained variance in students' reading achievement (7%).

The Index of Early Home Literacy Activities (EHLA) in PIRLS shows similar results as the HER with regard to two criteria. The median amount of missing data is 6.8%. The reliability of the index (Cronbach's alpha) is 0.67. Nevertheless, the correlation of this variable with the achievement is quite low with only 0.15. The same applies for the median of the explained variance in reading achievement which is only 2%.

The Home Possessions scale in PISA (HOMEPOSS) has very small amount of missing values (0.3) and the median reliability across countries is quite sufficient (0.75). The scale shows quite strong association with achievement on the three tested subjects – for reading the correlation coefficient is 0.28, and for math and science is 0.29. The explained variance in achievement is 8% for reading and science and 0.9 for math.

The Home Educational Resources (HEDRES) scale in PISA shows only a very small amount of missing data (median of 0.5%). The median reliability of the scale across the selected country is moderate – 0.56. The correlation between this measure of family background scale and reading achievement is 0.27. The same median correlation coefficient is found for math and science achievement of the students. The median amount of variance explained by the scale in the reading, math and science achievement is between 7 and 8%.

The Cultural Possessions scale (CULTPOSS) in PISA shows satisfactory reliability of 0.60 and correlation with achievement between 0.23 and 0.26 for the three tested subjects. The explained variance is between 5% and 7%.

The Index of Wealth Possessions (WEALTH) shows moderate reliability (0.64). Nevertheless, the association with achievement is quite weak. The correlation of this index with achievement is between 0.12 (reading) and 0.18 (math). The amount of explained variance for reading and science is 2% and for math is 3%, which is quite small.

The reliability for the Index of Economic, Social and Cultural Status (ESCS) is not very high (0.69). The correlations of this index with achievement are fairly strong for all the three subjects: reading – 0.33; math – 0.36; science – 0.34. This also applies to the amount of the variance explained by this variable – reading and science explain 11% and math explains 13%. This is somewhat expected because the index combines information and explanatory power from three sources (the index of home possessions, the highest ISEI and the parental education counted in years of schooling).

5 Discussion

Before discussing the results of the current study in detail, it is necessary to point to some general tendencies first. The overall impression is that data obtained by parents in both PIRLS and PISA tends to have a higher

[5] England was excluded from the calculation of all median statistics for this index due to the low amount of valid data.

amount of missing data compared to data provided by students. In some cases the median amount of missingness in the parent's data is about 15% and in one case (occupation of mother in PISA) it is almost 40%. The reasons why information collected from parents' consists of a much higher amount of missingness could be many and different, from low interest to unwillingness to complete the questionnaire or separate parts of it. It could also be that parents are not willing to provide information they think is too sensitive.

As stated in the methodology chapter of this paper, the studies were paired: 1) PIRLS and TIMSS grade 4 and 2) PISA and TIMSS grade 8. Additionally, only the data from countries that these pairs of studies have in common is analyzed. This allows for analyzing the data comparing the results for the same age groups and the same countries that participated in the assessments.

The different domains of family background (home possessions, parental education, etc.) show different strengths of association with achievement for different subjects across different studies. The frequency of language spoken at home (the only non-dichotomous language variable) shows the weakest relationship with achievement for all subjects amongst all domains. In most cases the correlation is between 0.03 and 0.13 with only two exceptions (TIMSS – math and science) where it is up to 0.18. Also, the variance in achievement which is explained by the language at home is lowest for all domains.

For the immigrant status variables the correlations are also very weak in most cases. However, in TIMSS grade 4 the amount of explained variance is 5% for each subject. The immigrant status of the parents plays only a minor role. The pattern that the information about if the student was born in the country of test has more explanatory power than the information about if the parents were born in the country of test is similar to TIMSS grade 8 data, but on a much lower level. PISA data hardly shows any relationship between the immigration background of the students with achievement. For the majority of the countries the correlation and the explained variation in achievement are rather low although in some countries regression results are statistically significant. This would suggests that immigration status might play a role for achievement in the younger age group (at least for TIMSS grade 4), but not in the older group (PISA and TIMSS grade 8). Another interesting finding is that in PISA and TIMSS grade 4 and grade 8 the median relationship between the students' age of immigration to the country of test with achievement is negative. The older students are when immigrating, the lower their achievement tends to be. However, this cannot be regarded as a tendency because the correlation between this variable and the achievement in different subjects varies a lot between countries and is very weak (below 0.10 in absolute terms) in majority of them. In some countries it is even positive, but again very weak.

The variables related with the occupation of parents show stronger relationship with the educational outcomes of the students. Unfortunately, such variables do not exist for TIMSS data. For PISA all occupational variables show relatively strong correlations with the three subject domains (0.22 – 0.29 for reading; 0.22 – 0.31 for math; 0.23 – 0.30 for science). The amount of explained variance in achievement is between 5% and 10% for all three subjects. Although the association of the occupational variables with achievement is substantial, the amount of missing data is quite high, especially for the mothers' job. Unfortunately, the occupational variables used in PIRLS are on nominal scale, making a direct comparison impossible.

No comparison can be made between PIRLS and TIMSS grade 4 on parental education variables because they were not administered in TIMSS grade 4. For the other studies, the correlation between these variables and achievement on all tested subjects tends to be strong and the explained variance is quite large. When

comparing PISA and TIMSS grade 8 data, the obtained correlations are a bit higher for TIMSS, but in general the difference in the actual numbers is very small and can be neglected. This also applies to the amount of explained variance in achievement. It can be argued that from all domains of family background that were discussed so far, the variables on parents' education is the strongest predictor of achievement.

The domain of home possessions has been operationalized using the biggest number of items amongst all five background domains. However, only a few of the items show substantive association with achievement. In all three studies the number of books at home appears to be the strongest predictor of the reading achievement with coefficients up to 0.33 and explained variance between 8% and 12% across different studies and tested subjects. This also applies to the reading achievement in PIRLS and the number of children's books at home. In general the presence of educational aids at home show low (median explained variance of 5% or lower) or none association with achievement. The same applies to items of everyday life like dishwashers, cars, TVs, cell phones and others. The availability of computer at home shows relatively strong correlation and sufficient amount of explained variance in PISA for all subjects, but has less explanatory power for TIMSS grade 8 data. In both PIRLS and TIMSS grade 4 the correlation of this variable with achievement is even lower and the amount of explained variance in achievement on any subject is small. The association of internet connection with achievement is also low. In general, all country specific (optional) home possessions show very small amount of explained variance in achievement – only 1% or 2% across tested subjects.

The reliability of the derived scales (PIRLS and PISA) is in most cases moderate, below 0.65, with only three exceptions. In general there are variables that show strong association with achievement across the three studies and different age cohorts, but not all background domains and single items within the domains show such strong relationship as described in the literature. The indices in PIRLS show satisfactory quality in general although the reliability of the Index of Home Educational Resources is below 0.65. Nevertheless, this variable has quite strong association with reading achievement. Although the Index of Early Home Literacy Activities has a higher reliability, the association with achievement on the other hand is quite low. For the Index of Home Educational Resources in PISA the median reliability is quite low, although it shows strong association with achievement. On the contrary, the Index of Family Wealth Possession in PISA has satisfactory median reliability, but the association of this variable with achievement is the weakest of all PISA indices. The highest reliability and association with achievement in PISA is found with the Home Possessions scale and the Index of Economic, Social and Cultural Status.

Based on the analyses conducted so far, there are several recommendations regarding the measurement of family background:

1. From all home possessions it seems sufficient to include the ones that show the highest association with achievement in terms of explained variance: number of books in the home, number of children's books in the home, number of student's own books, and computer. This applies to all three studies – TIMSS, PIRLS, and PISA. Further, the optional home possessions that countries can add seem to show negligible association with achievement and their omission should be considered.
2. TIMSS does not derive any scales or indices of family background, although in general these kind of derived variables have shown their predictive power regarding achievement. Such indices should be created and reported in future TIMSS cycles. For example, research conducted by May (2002) show

that for TIMSS a reliable, valid, and internationally comparable SES scale can be created and used successfully in analyses of study data.

3. TIMSS does not collect any occupational data although these variables have shown their importance in other studies and also in this paper. Single measures on employment situation in PIRLS show weak relationship with achievement, but it could be different if they comprise a scale together with other occupation measures. As collecting information about parental occupation from students at grade 4 does not seem to be reasonable, future TIMSS cycles might consider using a home questionnaire for that grade. In TIMSS grade 8 information about parents' occupation could be collected from students since other studies have already shown that students at this age can provide reliable data about their parents.
4. PIRLS collects parental occupation data, but only on nominal scale level. A finer indicator would be desirable to be able to analyze the effect of family background in more depth.
5. Both TIMSS and PIRLS should consider constructing background indices using more complex methods, following examples like Van Damme, Liu, Vanhee and Pustjens (2010), who derive an SES index for PIRLS that shows good quality and accounts for a high amount of explained variance in achievement.
6. PISA derives several scales of aspects of family background, but the reliability tends to be rather low for some of them. A review of the composition of the scales and further research on optimized operationalizations of aspects of family background might foster improving measures of family background.

This paper was intended to provide an overview about the existing measures of family background in PIRLS 2006, PISA 2006, and TIMSS 2007 and to evaluate their strengths and weaknesses with regard to the criteria of missingness, reliability (of scales) and association with students' achievement. Further research would be desirable with regard to several aspects. First, the possibility to derive a reasonable scale out of the TIMSS data should be explored. Currently, TIMSS only reports on single items of family background. Second, the scales and indices reported in PIRLS and PISA should be reviewed with regard to the question to what extend the quality of scales (in terms of bias, reliability and validity) and the association with achievement changes if items or components with low quality (in terms of missingness and reliability) were removed. Furthermore, the current project concentrated on the results from a set of countries. A cross-cultural validity analysis should be undertaken to find out what are the differences between countries with regard to the functioning of the scales and single variables across countries.

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Appendix

Table A.1 Items and variables in the TIMSS 2007 Student Questionnaire related with family background.

Item Content	*Description*	*Variable 4th Grade*	*Variable 8th Grade*
Language	How often do you speak <language of test> at home?	AS4GOLAN	BS4GOLAN
Books in the home	About how many books are there in your home? (Do not count magazines, newspapers, or your school books.)	AS4GBOOK	BS4GBOOK
Home possessions	Do you have a calculator in your home?	AS4GTH01 (int)	BS4GTH01 (int)
	Do you have a computer in your home? (do not include PlayStationGameCube®, XBox®, or other TV/video game computers)	AS4GTH02 (int)	BS4GTH02 (int)
	Do you have a study desk/table for your use in your home?	AS4GTH03 (int)	BS4GTH03 (int)
	Do you have a dictionary in your home?	AS4GTH04 (int)	BS4GTH04 (int)
	Do you have an Internet connection in your home?	AS4GTH05 (int)	BS4GTH05 (int)
	Do you have a <country-specific> in your home?	AS4GTH06 (nat)	BS4GTH06 (nat)
	Do you have a <country-specific> in your home?	AS4GTH07 (nat)	BS4GTH07 (nat)
	Do you have a <country-specific> in your home?	AS4GTH08 (nat)	BS4GTH08 (nat)
	Do you have a <country-specific> in your home?	AS4GTH09 (nat)	BS4GTH09 (nat)
Parents born in country	Was your mother (or stepmother or female guardian) born in <country>?	AS4GMBRN	BS4GMBRN
	Was your father (or stepfather or male guardian) born in <country>?	AS4GFBRN	BS4GFBRN
	Parents born in country	ASDGBORN	BSDGBORN
Student born in country	Were you born in <country>?	AS4GBORN	BS4GBORN
	If you were not born in <country>, how old were you when you came to <country>?	(AS4GBRNC)	(BS4GBRNC)
Parents' education	What is the highest level of education completed by your mother (or stepmother or female guardian)?	-	BS4GMFED
	What is the highest level of education completed by your father (or stepfather or male guardian)?		BS4GFMED
	Parents' highest education level		BSDGEDUP

Table A.2 Items and variables in the PIRLS 2006 Student Questionnaire related with family background.

Item Content	*Description*	*Variable*
Language	How often do you speak <language of test> at home?	ASBGLNGH
Books in the home	About how many books are there in your home?	ASBGBOOK
Home possessions	Do you have a computer at home?	ASBGTA1 (int)
	Do you have a study desk/table for your use at home?	ASBGTA2 (int)
	Do you have books of your very own (not school books) at home?	ASBGTA3 (int)
	Do you have a daily newspaper at home?	ASBGTA4 (int)
	Do you have your own room at home?	ASBGTA5 (int)
	Do you have your own mobile (cellular) phone at home?	ASBGTA6 (int)
	Do you have <country-specific indicator of wealth> at home?	ASBGTA7 (nat)
	Do you have <country-specific indicator of wealth> at home?	ASBGTA8 (nat)
	Do you have <country-specific indicator of wealth> at home?	ASBGTA9 (nat)
	Do you have <country-specific indicator of wealth> at home?	ASBGTA19 (nat)
Parents born in country	Was your mother born in <country>?	ASBGBRNM
	Was your father born in <country>?	ASBGBRNF
	Students' parents born in country	ASDGBRN
Student born in country	Were you born in <country>?	ASBGBRN1

Table A.3 Items and variables in the PIRLS 2006 Learning to Read Survey (home questionnaire) related with family background.

Item Content	*Description*	*Variable*
Language of books	Are these (children's books) books mainly in <language of test>?	ASBHCHBL
Language spoken	When talking at home with your child, what language does the child's father us most often? When talking at home with your child, what language does the child's mother us most often?	ASBHLAHF ASBHLAHM
Books in the home	About how many books are there in your home?	ASBHBOOK
Children's books in the home	About how many children's books are there in your home?	ASBHCHBK
Parents' education	What is the highest level of education completed by the child's father/ stepfather/male guardian? What is the highest level of education completed by the child's mother/ stepmother/female guardian? Parent's highest education	ASBHLEDF ASBHLEDM ASDHEDUP
Parents' employment situation	What best describes the employment situation of the child's father/ stepfather/male guardian? What best describes the employment situation of the child's mother/ stepmother/female guardian? Parents' employment situation	ASBHEMPF ASBHEMPM ASDHPEMP
Parents' main job	What kind of work does the child's father/stepfather/male guardian do for his main job? What kind of work does the child's mother/stepmother/female guardian do for her main job? Parent's highest occupation level	ASBHMJF ASBHMJM ASDHOCCP
Family financially well-off	Compared with other families, how well-off do you think your family if financially?	ASBHWELL

Table A.4 Items and variables in the PISA 2006 student questionnaire related with the family background.

Item Content	*Description*	*Variable*
Language	What language do you speak at home most of the time?	ST12Q01
Books in the home	How many books are there in your home?	ST15Q01
Home possessions	A desk to study at	ST13Q01 (int)
	A room of your own	ST13Q02 (int)
	A quiet place to study	ST13Q03 (int)
	A computer you can use for school work	ST13Q04 (int)
	Educational software	ST13Q05 (int)
	A link to the Internet	ST13Q06 (int)
	Your own calculator	ST13Q07 (int)
	Classic literature (e.g. <Shakespeare>)	ST13Q08 (int)
	Books of poetry	ST13Q09 (int)
	Works of art (e.g. paintings)	ST13Q10 (int)
	Books to help with your school work	ST13Q11 (int)
	A dictionary	ST13Q12 (int)
	A dishwasher	ST13Q13 (int)
	A <DVD or VCR> player	ST13Q14 (int)
	<Country-specific wealth item 1>	ST13Q15 (nat)
	<Country-specific wealth item 2>	ST13Q16 (nat)
	<Country-specific wealth item 3>	ST13Q17 (nat)
	Cellular phones	ST14Q1 (int)
	Televisions	ST14Q2 (int)
	Computers	ST14Q3 (int)
	Cars	ST14Q4 (int)
Parents born in country	In what country were you and your parents born?	
	Mother	ST11Q02
	Father	ST11Q03
	Country of birth (Mother) 5-digit code	COBN_M
	Country of birth (Father) 5-digit code	COBN_F
Student born in country	In what country were you and your parents born?	
	Student	ST11Q01
	(If you were NOT born in <country of test>, how old were you when you arrived in <country of test>?)	(ST11Q04)
	Country of birth (Self) 5-digit code	COBN_S
Occupation of parents (ISEI coded (through ISCO coding)	Occupational status of the mother	BMMJ
	Occupational status of the father	BFMJ
	Highest occupational status of the parents	HISEI
Education of parents (ISCED categories)	Educational level of the mother	MISCED
	Educational level of the father	FISCED
	Highest educational level of parents	HISCED

Table A.5 Items and variables in the PISA 2006 parent questionnaire related with the family background.

Item Content	*Description*	*Variable*
Household income	What is your annual household income? (relative to country median)	PA15Q01
Occupation of parents (ISEI coded)	Occupational status Mother	PQBMMJ
	Occupational status Father	PQBFMJ
	Highest parental occupational status	PQHISEI
Education of parents (ISCED categories)	Educational level of mother	PQMISCED
	Educational level of father	PQFISCED
	Highest educational level of parents	PQHISCED

Table A.6 Scales derived in PIRLS 2006.

Name of scale	*Items used to derive scale*	*Variable name*
Index of Home Educational Resources	ASBGBOOK ASBGTA1-4 ASBHCHBK ASDHEDUP	ASDHHER
Index of Early Home Literacy Activities	ASBHHA01 ASBHHA04 ASBHHA02 ASBHHA07 ASBHHA03 ASBHHA09	ASDHEHLA

Table A.7 Scales and indices derived in PISA 2006.

Name of scale	*Items used to derive scale*			*Variable name*
Cultural possessions at home	ST13Q08 ST13Q09 ST13Q10			CULTPOSS
Index of home possessions	ST13Q01 ST13Q02 ST13Q03 ST13Q05 ST13Q06 ST13Q07 ST13Q08	ST13Q09 ST13Q10 ST13Q11 ST13Q12 ST13Q13 ST13Q14 ST13Q15	ST13Q16 ST13Q17 ST14Q01 ST14Q02 ST14Q03 ST14Q04 ST15Q01	HOMEPOS
Home educational resources	ST13Q01 ST13Q03 ST13Q04 ST13Q05	ST13Q07 ST13Q11 ST13Q12		HEDRES
Family wealth	ST13Q02 ST13Q06 ST13Q13 ST13Q14 ST13Q15 ST13Q16	ST13Q17 ST14Q01 ST14Q02 ST14Q03 ST14Q04		WEALTH
Index of economic, social and cultural status	HISEI PARED HOMEPOS			ESCS

Table A.8 Countries participating in PIRLS 2006, PISA 2006 and TIMSS 2007

Country / Education System	PIRLS 2006	TIMSS 2007 (4th Grade)	PISA 2006	TIMSS 2007 (8th Grade)
Algeria		●		●
Argentina			●	
Armenia		●		●
Australia		●	●	●
Austria	●	●	●	
Azerbaijan			●	
Bahrain				●
Belgium			●	
Belgium (Flemish)	●			
Belgium (French)	●			
Bosnia and Herzegovina				●
Botswana				●
Brazil			●	
Bulgaria	●		●	●
Canada			●	
Canada, Alberta	●			
Canada, British Columbia	●			
Canada, Nova Scotia	●			
Canada, Ontario	●			
Canada, Quebec	●			
Chile			●	
Chinese Taipei	●	●	●	●
Colombia		●	●	●
Croatia			●	
Cyprus				●
Czech Republic		●	●	●
Denmark	●	●	●	
Egypt				●
El Salvador		●		●
England	●	●		●
Estonia			●	
Finland			●	
France	●		●	
Georgia	●	●		●
Germany	●	●	●	
Ghana				●
Greece			●	
Hong Kong SAR	●	●	●	●
Hungary	●	●	●	●
Iceland	●		●	
Indonesia	●		●	●
Iran, Islamic Rep. of	●	●		●
Ireland			●	
Israel	●		●	●
Italy	●	●	●	●
Japan		●	●	●
Jordan			●	●
Kazakhstan		●		
Korea, Rep. of			●	●
Kuwait	●	●		●
Kyrgyzstan			●	
Latvia	●	●	●	
Lebanon				●

Country / Education System	PIRLS 2006	TIMSS 2007 (4th Grade)	PISA 2006	TIMSS 2007 (8th Grade)
Liechtenstein			●	
Lithuania	●	●	●	●
Luxembourg	●		●	
Macao-China			●	
Macedonia, Rep. of	●			
Malaysia				●
Malta				●
Mexico			●	
Moldova, Rep. of	●			
Mongolia		●		●
Montenegro			●	
Morocco	●	●		●
Netherlands	●	●	●	
New Zealand	●	●	●	
Norway	●	●	●	●
Oman				●
Palestinian Nat'l Auth.				●
Poland	●		●	
Portugal			●	
Qatar	●	●	●	●
Romania	●		●	●
Russian Federation	●	●	●	●
Saudi Arabia				●
Scotland	●	●		●
Serbia			●	●
Singapore	●	●		●
Slovak Republic	●	●	●	
Slovenia	●	●	●	●
South Africa	●			
Spain	●		●	
Sweden	●	●	●	●
Switzerland			●	
Syrian Arab Republic				●
Thailand			●	●
Trinidad and Tobago	●			
Tunisia		●	●	●
Turkey			●	●
Ukraine		●		●
United Kingdom			●	
United States	●	●	●	●
Uruguay			●	
Yemen		●		
Benchmarking Participants				
Alberta, Canada		●		
Basque Country, Spain				●
British Columbia, Canada		●		●
Dubai, UAE		●		●
Massachusetts, US		●		●
Minnesota, US		●		●
Ontario, Canada		●		●
Quebec, Canada		●		●

Countries participating in TIMSS 2007 8th grade and PISA 2006
Countries participating in TIMSS 2007 4th grade and PIRLS 2006
Countries participating in TIMSS 2007 4th and 8th grade, PISA 2006 and PIRLS 2006

For the first pair (PIRLS 2006 and TIMSS 2007 4th grade), there are 25 countries in common for both studies: Austria, Chinese Taipei, Denmark, England, Georgia, Germany, Hong Kong SAR, Hungary, Iran, Islamic Rep. of, Italy, Kuwait, Latvia, Lithuania, Morocco, Netherlands, New Zealand, Norway, Qatar, Russian Federation, Scotland, Singapore, Slovak Republic, Slovenia, Sweden, United States.

For the second pair (PISA 2006 and TIMSS 2007 8th grade), there are again 25 countries (but a different set of countries): Australia, Bulgaria, Chinese Taipei, Colombia, Czech Republic, Hong Kong SAR, Hungary, Indonesia, Israel, Italy, Japan, Jordan, Korea, Rep. of, Lithuania, Norway, Qatar, Romania, Russian Federation, Serbia, Slovenia, Sweden, Thailand, Tunisia, Turkey, United States.

Table A.9 Analysis results for parents' education

				Subject	Not Subject related				Reading					Math					Science				
Concept	**Study**	**Respondent**	**Item**	**Item Content**	**M1**	**M2**	**M3**	**M4**	**C1**	**C2**	**R1**	**R2**	**R3**	**C1**	**C2**	**R1**	**R2**	**R3**	**C1**	**C2**	**R1**	**R2**	**R3**
Education	PIRLS	Parents	ASBHLEDF	Father's education	14,9	20,1	-	-	0,29	0,06	0,09	0,03	24 / 24	-	-	-	-	-	-	-	-	-	-
Education	PIRLS	Parents	ASBHLEDM	Mother's education	12,2	19,9	-	-	0,30	0,07	0,09	0,04	24 / 24	-	-	-	-	-	-	-	-	-	-
Education	PIRLS	Parents	ASDHEDUP	Parents' education	10,1	18,9	-	-	0,31	0,10	0,09	0,06	24 / 24	-	-	-	-	-	-	-	-	-	-
Education	PISA	Student	MISCED	Education of mother	-	-	1,6	2,5	0,20	0,09	0,04	0,03	24 / 24	0,25	0,09	0,06	0,04	25 / 25	0,23	0,09	0,05	0,04	25 / 25
Education	PISA	Student	FISCED	Education of father	-	-	3,2	5,0	0,20	0,10	0,04	0,05	24 / 24	0,24	0,10	0,06	0,05	25 / 25	0,23	0,09	0,05	0,04	25 / 25
Education	PISA	Student	HISCED	Education of parents	-	-	0,8	1,9	0,22	0,10	0,05	0,04	24 / 24	0,26	0,10	0,07	0,05	25 / 25	0,24	0,10	0,06	0,05	25 / 25
Education	PISA	Student	PARED	Highest parental education in years	-	-	0,8	1,9	0,22	0,10	0,05	0,05	24 / 24	0,24	0,11	0,06	0,05	25 / 25	0,24	0,09	0,06	0,05	25 / 25
Education	PISA	Parents	PQMISCED	Education of mother	14,5	12,5	-	-	0,21	0,07	0,04	0,03	7 / 7	0,26	0,12	0,07	0,06	7 / 7	0,22	0,09	0,05	0,05	7 / 7
Education	PISA	Parents	PQFISCED	Education of father	10,9	12,7	-	-	0,26	0,11	0,07	0,05	7 / 7	0,28	0,11	0,08	0,06	7 / 7	0,25	0,12	0,06	0,06	7 / 7
Education	PISA	Parents	PQHISCED	Education of parents	9,7	10,3	-	-	0,24	0,10	0,06	0,05	7 / 7	0,29	0,10	0,08	0,06	7 / 7	0,25	0,11	0,06	0,06	7 / 7
Education	TIMSS 8	Student	BS4GMFED	HIGHEST EDUCATION LEVEL\MOTHER	-	-	1,5	1,9	-	-	-	-	-	0,28	0,08	0,08	0,04	25 / 25	0,28	0,08	0,08	0,04	25 / 25
Education	TIMSS 8	Student	BS4GFMED	HIGHEST EDUCATION LEVEL\FATHER	-	-	1,8	2,1	-	-	-	-	-	0,30	0,06	0,09	0,04	25 / 25	0,27	0,08	0,07	0,05	25 / 25
Education	TIMSS 8	Student	BSDGEDUP	PARENTS' HIGHEST EDUCATION LEVEL	-	-	1,3	1,5	-	-	-	-	-	0,30	0,07	0,09	0,04	25 / 25	0,30	0,06	0,09	0,03	25 / 25

M1 = Median % of missing data including unit-non-response
M2 = Interquartile range of % of missing data including unit-non-response
M3 = Median % of missing data not including unit-non-response
M4 = Interquartile range of % of missing data not including unit-non-response
C1 = Median Pearson correlation coefficient
C2 = Interquartile range of Pearson correlation coefficient
R1 = Median of explained variance in simple linear regression model
R2 = Interquartile range of of explained variance in simple linear regression model
R3 = Proportion of countries with significant relationship in simple linear regression model
- = Analysis type not applicable

Table A.10 Analysis results for home possessions (PIRLS 2006 and TIMSS 4th grade)

				Subject	Not Subject related				Reading					Math					Science				
Concept	**Study**	**Respondent**	**Item**	**Item Content**	**M1**	**M2**	**M3**	**M4**	**C1**	**C2**	**R1**	**R2**	**R3**	**C1**	**C2**	**R1**	**R2**	**R3**	**C1**	**C2**	**R1**	**R2**	**R3**
Home Possessions	PIRLS	Student	ASBGBOOK	Books in the home	-	-	2,7	7,1	0,30	0,10	0,09	0,06	25 / 25	-	-	-	-	-	-	-	-	-	-
Home Possessions	PIRLS	Student	ASBGTA1	Home possessions - PC	-	-	1,8	3,7	-	-	0,02	0,02	22 / 25	-	-	-	-	-	-	-	-	-	-
Home Possessions	PIRLS	Student	ASBGTA2	Home possessions - OWN STUDY DESK,TABLE	-	-	1,5	2,5	-	-	0,01	0,02	24 / 25	-	-	-	-	-	-	-	-	-	-
Home Possessions	PIRLS	Student	ASBGTA3	Home possessions - OWN BOOKS	-	-	1,4	2,8	-	-	0,04	0,04	25 / 25	-	-	-	-	-	-	-	-	-	-
Home Possessions	PIRLS	Student	ASBGTA4	Home possessions - DAILY NEWSPAPER	-	-	1,6	3,0	-	-	0,02	0,03	20 / 25	-	-	-	-	-	-	-	-	-	-
Home Possessions	PIRLS	Student	ASBGTA5	Home possessions - OWN ROOM	-	-	1,5	2,7	-	-	0,00	0,01	15 / 25	-	-	-	-	-	-	-	-	-	-
Home Possessions	PIRLS	Student	ASBGTA6	Home possessions - OWN MOBILE PHONE	-	-	1,5	2,7	-	-	0,01	0,02	20 / 25	-	-	-	-	-	-	-	-	-	-
Home Possessions	PIRLS	Student	ASBGTA7	Home possessions - <COUNTRY-SPECIFIC 1>	-	-	1,7	2,5	-	-	0,01	0,02	23 / 25	-	-	-	-	-	-	-	-	-	-
Home Possessions	PIRLS	Student	ASBGTA8	Home possessions - <COUNTRY-SPECIFIC 2>	-	-	1,6	2,3	-	-	0,02	0,04	19 / 23	-	-	-	-	-	-	-	-	-	-
Home Possessions	PIRLS	Student	ASBGTA9	Home possessions - <COUNTRY-SPECIFIC 3>	-	-	2,3	2,7	-	-	0,01	0,03	15 / 21	-	-	-	-	-	-	-	-	-	-
Home Possessions	PIRLS	Student	ASBGTA10	Home possessions - <COUNTRY-SPECIFIC 4>	-	-	1,6	2,2	-	-	0,00	0,00	7 / 15	-	-	-	-	-	-	-	-	-	-
Home Possessions	PIRLS	Parents	ASBHBOOK	Books in the home	6,1	13,4	-	-	0,29	0,06	0,08	0,04	24 / 24	-	-	-	-	-	-	-	-	-	-
Home Possessions	PIRLS	Parents	ASBHCHBK	Children's books in the home	5,9	13,4	-	-	0,30	0,10	0,09	0,06	24 / 24	-	-	-	-	-	-	-	-	-	-
Home Possessions	TIMSS 4	Student	AS4GBOOK	NR OF BOOKS IN YOUR HOME	-	-	2,1	2,8	-	-	-	-	-	0,25	0,11	0,06	0,06	24 / 25	0,29	0,15	0,09	0,08	23 / 25
Home Possessions	TIMSS 4	Student	AS4GTH01	Home possessions - CALCULATOR	-	-	2,2	2,1	-	-	-	-	-	-	-	0,02	0,02	23 / 25	-	-	0,02	0,02	24 / 25
Home Possessions	TIMSS 4	Student	AS4GTH02	Home possessions - COMPUTER	-	-	2,8	6,1	-	-	-	-	-	-	-	0,03	0,02	24 / 25	-	-	0,03	0,02	24 / 25
Home Possessions	TIMSS 4	Student	AS4GTH03	Home possessions - STUDY DESK	-	-	1,3	2,3	-	-	-	-	-	-	-	0,01	0,01	21 / 25	-	-	0,02	0,02	22 / 25
Home Possessions	TIMSS 4	Student	AS4GTH04	Home possessions - DICTIONARY	-	-	1,4	2,3	-	-	-	-	-	-	-	0,03	0,02	25 / 25	-	-	0,02	0,03	25 / 25
Home Possessions	TIMSS 4	Student	AS4GTH05	Home possessions - INTERNET CONNECTION	-	-	1,5	2,2	-	-	-	-	-	-	-	0,02	0,04	24 / 25	-	-	0,02	0,03	23 / 25
Home Possessions	TIMSS 4	Student	AS4GTH06	Home possessions - <COUNTRY SPECIFIC>	-	-	1,5	1,2	-	-	-	-	-	-	-	0,01	0,02	16 / 22	-	-	0,01	0,03	17 / 22
Home Possessions	TIMSS 4	Student	AS4GTH07	Home possessions - <COUNTRY SPECIFIC>	-	-	1,2	1,6	-	-	-	-	-	-	-	0,01	0,01	19 / 22	-	-	0,02	0,02	20 / 22
Home Possessions	TIMSS 4	Student	AS4GTH08	Home possessions - <COUNTRY SPECIFIC>	-	-	1,6	0,7	-	-	-	-	-	-	-	0,02	0,02	17 / 21	-	-	0,01	0,02	17 / 21
Home Possessions	TIMSS 4	Student	AS4GTH09	Home possessions - <COUNTRY SPECIFIC>	-	-	1,2	0,9	-	-	-	-	-	-	-	0,01	0,02	10 / 16	-	-	0,01	0,02	11 / 16

M1 = Median % of missing data including unit-non-response
M2 = Interquartile range of % of missing data including unit-non-response
M3 = Median % of missing data not including unit-non-response
M4 = Interquartile range of % of missing data not including unit-non-response
C1 = Median Pearson correlation coefficient
C2 = Interquartile range of Pearson correlation coefficient
R1 = Median of explained variance in simple linear regression model
R2 = Interquartile range of of explained variance in simple linear regression model
R3 = Proportion of countries with significant relationship in simple linear regression model
- = Analysis type not applicable

Table A.11 Analysis results for home possessions (PISA 2006 and TIMSS 2007 8th grade)

				Subject	Not Subject related				Reading					Math					Science				
Concept	Study	Respondent	Item	Item Content	M1	M2	M3	M4	C1	C2	R1	R2	R3	C1	C2	R1	R2	R3	C1	C2	R1	R2	R3
Home Possessions	PISA	Student	ST15Q01	Books in the home	-	-	1,3	2,7	0,32	0,11	0,10	0,07	24 / 24	0,33	0,11	0,11	0,07	25 / 25	0,35	0,12	0,12	0,08	25 / 25
Home Possessions	PISA	Student	ST13Q01	Possessions desk Q13a	-	-	1,0	1,9	-	-	0,01	0,03	24 / 24	-	-	0,02	0,02	25 / 25	-	-	0,01	0,03	25 / 25
Home Possessions	PISA	Student	ST13Q02	Possessions own room Q13b	-	-	0,9	1,5	-	-	0,00	0,00	13 / 24	-	-	0,00	0,01	17 / 25	-	-	0,00	0,00	15 / 25
Home Possessions	PISA	Student	ST13Q03	Possessions study place Q13c	-	-	1,3	2,0	-	-	0,01	0,01	24 / 24	-	-	0,01	0,01	23 / 25	-	-	0,01	0,01	24 / 25
Home Possessions	PISA	Student	ST13Q04	Possessions computer Q13d	-	-	1,3	1,9	-	-	0,05	0,06	24 / 24	-	-	0,06	0,08	25 / 25	-	-	0,05	0,07	25 / 25
Home Possessions	PISA	Student	ST13Q05	Possessions software Q13e	-	-	2,9	3,3	-	-	0,02	0,02	22 / 24	-	-	0,03	0,04	24 / 25	-	-	0,03	0,02	23 / 25
Home Possessions	PISA	Student	ST13Q06	Possessions Internet Q13f	-	-	2,0	2,2	-	-	0,03	0,03	24 / 24	-	-	0,04	0,04	25 / 25	-	-	0,04	0,05	25 / 25
Home Possessions	PISA	Student	ST13Q07	Possessions calculator Q13g	-	-	1,1	1,9	-	-	0,01	0,02	24 / 24	-	-	0,01	0,02	25 / 25	-	-	0,01	0,01	25 / 25
Home Possessions	PISA	Student	ST13Q08	Possessions literature Q13h	-	-	2,4	2,5	-	-	0,07	0,06	23 / 24	-	-	0,05	0,04	24 / 25	-	-	0,06	0,04	24 / 25
Home Possessions	PISA	Student	ST13Q09	Possessions poetry Q13i	-	-	2,0	2,2	-	-	0,03	0,05	23 / 24	-	-	0,02	0,04	25 / 25	-	-	0,03	0,04	24 / 25
Home Possessions	PISA	Student	ST13Q10	Possessions art Q13j	-	-	2,3	2,0	-	-	0,02	0,03	23 / 24	-	-	0,02	0,02	22 / 25	-	-	0,02	0,02	22 / 25
Home Possessions	PISA	Student	ST13Q11	Possessions textbooks Q13k	-	-	1,4	1,8	-	-	0,03	0,02	24 / 24	-	-	0,02	0,02	25 / 25	-	-	0,03	0,03	25 / 25
Home Possessions	PISA	Student	ST13Q12	Possessions dictionary Q13l	-	-	1,1	1,2	-	-	0,02	0,02	24 / 24	-	-	0,02	0,02	25 / 25	-	-	0,02	0,03	25 / 25
Home Possessions	PISA	Student	ST13Q13	Possessions dishwasher Q13m	-	-	2,0	2,6	-	-	0,01	0,01	18 / 23	-	-	0,01	0,01	17 / 24	-	-	0,01	0,01	18 / 24
Home Possessions	PISA	Student	ST13Q14	Possessions <DVD or VCR> Q13n	-	-	1,1	1,9	-	-	0,00	0,01	19 / 24	-	-	0,01	0,01	19 / 25	-	-	0,00	0,01	20 / 25
Home Possessions	PISA	Student	ST13Q15	Possessions <country-specific item 1> Q13o	-	-	2,6	1,9	-	-	0,01	0,02	18 / 24	-	-	0,01	0,03	18 / 25	-	-	0,01	0,02	17 / 25
Home Possessions	PISA	Student	ST13Q16	Possessions <country-specific item 2> Q13p	-	-	2,1	2,3	-	-	0,01	0,02	20 / 24	-	-	0,01	0,02	20 / 25	-	-	0,01	0,02	21 / 25
Home Possessions	PISA	Student	ST13Q17	Possessions <country-specific item 3> Q13q	-	-	2,4	2,0	-	-	0,00	0,01	19 / 24	-	-	0,01	0,01	19 / 25	-	-	0,00	0,01	19 / 25
Home Possessions	PISA	Student	ST14Q01	How many cell phones Q14a	-	-	0,7	1,2	0,16	0,13	0,03	0,04	23 / 24	0,17	0,14	0,03	0,05	25 / 25	0,16	0,14	0,02	0,04	24 / 25
Home Possessions	PISA	Student	ST14Q02	How many televisions Q14b	-	-	0,7	0,8	0,02	0,20	0,01	0,01	21 / 24	0,04	0,21	0,01	0,03	19 / 25	0,02	0,21	0,01	0,02	21 / 25
Home Possessions	PISA	Student	ST14Q03	How many computers Q14c	-	-	1,3	2,3	0,22	0,12	0,05	0,04	23 / 24	0,27	0,14	0,07	0,06	25 / 25	0,25	0,11	0,06	0,05	24 / 25
Home Possessions	PISA	Student	ST14Q04	How many cars Q14d	-	-	1,4	2,7	0,04	0,09	0,00	0,01	16 / 24	0,08	0,12	0,01	0,02	20 / 25	0,08	0,11	0,01	0,02	20 / 25
Home Possessions	TIMSS 8	Student	BS4GBOOK	NR OF BOOKS IN YOUR HOME	-	-	0,7	1,3	-	-	-	-	-	0,33	0,08	0,11	0,05	25 / 25	0,34	0,12	0,12	0,08	25 / 25
Home Possessions	TIMSS 8	Student	BS4GTH01	Home possessions - CALCULATOR	-	-	1,2	1,1	-	-	-	-	-	-	-	0,02	0,02	25 / 25	-	-	0,02	0,02	24 / 25
Home Possessions	TIMSS 8	Student	BS4GTH02	Home possessions - COMPUTER	-	-	1,1	1,4	-	-	-	-	-	-	-	0,03	0,03	25 / 25	-	-	0,02	0,03	25 / 25
Home Possessions	TIMSS 8	Student	BS4GTH03	Home possessions - STUDY DESK	-	-	1,1	1,1	-	-	-	-	-	-	-	0,02	0,02	25 / 25	-	-	0,02	0,02	24 / 25
Home Possessions	TIMSS 8	Student	BS4GTH04	Home possessions - DICTIONARY	-	-	1,1	1,2	-	-	-	-	-	-	-	0,04	0,04	25 / 25	-	-	0,03	0,02	25 / 25
Home Possessions	TIMSS 8	Student	BS4GTH05	Home possessions - INTERNET CONNECTION	-	-	1,3	1,3	-	-	-	-	-	-	-	0,04	0,03	24 / 25	-	-	0,03	0,03	24 / 25
Home Possessions	TIMSS 8	Student	BS4GTH06	Home possessions - <COUNTRY SPECIFIC>	-	-	1,2	1,4	-	-	-	-	-	-	-	0,01	0,02	19 / 24	-	-	0,01	0,01	20 / 24
Home Possessions	TIMSS 8	Student	BS4GTH07	Home possessions - <COUNTRY SPECIFIC>	-	-	1,0	1,4	-	-	-	-	-	-	-	0,01	0,03	21 / 24	-	-	0,01	0,02	21 / 24
Home Possessions	TIMSS 8	Student	BS4GTH08	Home possessions - <COUNTRY SPECIFIC>	-	-	1,0	1,2	-	-	-	-	-	-	-	0,01	0,02	19 / 23	-	-	0,01	0,02	18 / 23
Home Possessions	TIMSS 8	Student	BS4GTH09	Home possessions - <COUNTRY SPECIFIC>	-	-	1,0	1,1	-	-	-	-	-	-	-	0,01	0,01	16 / 20	-	-	0,01	0,02	13 / 20

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M4 = Interquartile range of % of missing data not including unit-non-response
C1 = Median Pearson correlation coefficient
C2 = Interquartile range of Pearson correlation coefficient
R1 = Median of explained variance in simple linear regression model
R2 = Interquartile range of of explained variance in simple linear regression model
R3 = Proportion of countries with significant relationship in simple linear regression model
- = Analysis type not applicable

Table A.12 Analysis results for immigration status

				Subject	Not Subject related				Reading					Math					Science				
Concept	**Study**	**Respondent**	**Item**	**Item Content**	**M1**	**M2**	**M3**	**M4**	**C1**	**C2**	**R1**	**R2**	**R3**	**C1**	**C2**	**R1**	**R2**	**R3**	**C1**	**C2**	**R1**	**R2**	**R3**
Immigration Status	PIRLS	Student	ASBGBRNM	Mother born in country	-	-	1,6	2,5	-	-	0,01	0,02	18 / 25	-	-	-	-	-	-	-	-	-	-
Immigration Status	PIRLS	Student	ASBGBRNF	Father born in country	-	-	1,5	2,4	-	-	0,01	0,02	17 / 25	-	-	-	-	-	-	-	-	-	-
Immigration Status	PIRLS	Student	ASDGBRN	Parents born in country	-	-	5,5	7,0	-	-	0,00	0,01	11 / 25	-	-	-	-	-	-	-	-	-	-
Immigration Status	PIRLS	Student	ASBGBRN1	Student born in country	-	-	1,8	5,4	-	-	0,01	0,01	17 / 25	-	-	-	-	-	-	-	-	-	-
Immigration Status	TIMSS 4	Student	AS4GMBRN	MOTHER BORN IN <COUNTRY>	-	-	2,2	2,8	-	-	-	-	-	-	-	0,01	0,02	22 / 25	-	-	0,02	0,02	19 / 25
Immigration Status	TIMSS 4	Student	AS4GFBRN	FATHER BORN IN <COUNTRY>	-	-	2,6	2,4	-	-	-	-	-	-	-	0,01	0,02	19 / 25	-	-	0,02	0,03	20 / 25
Immigration Status	TIMSS 4	Student	ASDGBORN	PARENTS BORN IN COUNTRY	-	-	1,7	2,6	-	-	-	-	-	-	-	0,01	0,03	21 / 25	-	-	0,04	0,04	19 / 25
Immigration Status	TIMSS 4	Student	AS4GBORN	Student BORN IN <COUNTRY>	-	-	1,6	2,7	-	-	-	-	-	-	-	0,05	0,05	24 / 25	-	-	0,05	0,05	23 / 25
Immigration Status	TIMSS 4	Student	AS4GBRNC	Student BORN IN <COUNTRY>\AGE OF COMING	-	-	3,6	3,7	-	-	-	-	-	-	-	0,01	0,02	8 / 25	-	-	0,01	0,02	4 / 25
Immigration Status	PISA	Student	ST11Q02	Mother born in country Q11b	-	-	1,7	1,1	-	-	0,00	0,01	13 / 24	-	-	0,00	0,01	14 / 25	-	-	0,00	0,01	13 / 25
Immigration Status	PISA	Student	ST11Q03	Father born in country Q11c	-	-	2,2	2,0	-	-	0,00	0,01	14 / 24	-	-	0,00	0,01	14 / 25	-	-	0,00	0,01	14 / 25
Immigration Status	PISA	Student	ST11Q01	Student born in country Q11a	-	-	1,3	1,3	-	-	0,00	0,01	11 / 24	-	-	0,00	0,01	11 / 25	-	-	0,00	0,01	12 / 25
Immigration Status	PISA	Student	ST11Q04	Student's age of immigration	-	-	7,7	8,5	-0,09	0,19	0,01	0,04	7 / 24	-0,06	0,20	0,01	0,04	6 / 25	-0,07	0,20	0,01	0,05	6 / 25
Immigration Status	PISA	Student	IMMIG	Immigration status	-	-	1,9	1,6	0,03	0,07	0,00	0,01	15 / 24	0,03	0,09	0,00	0,01	16 / 25	0,04	0,08	0,00	0,01	16 / 25
Immigration Status	TIMSS 8	Student	BS4GMBRN	MOTHER BORN IN <COUNTRY>	-	-	1,6	1,5	-	-	-	-	-	-	-	0,00	0,01	18 / 25	-	-	0,00	0,01	15 / 25
Immigration Status	TIMSS 8	Student	BS4GFBRN	FATHER BORN IN <COUNTRY>	-	-	1,9	1,4	-	-	-	-	-	-	-	0,00	0,01	17 / 25	-	-	0,00	0,01	16 / 25
Immigration Status	TIMSS 8	Student	BSDGBORN	PARENTS BORN IN COUNTRY	-	-	1,4	1,6	-	-	-	-	-	-	-	0,00	0,01	19 / 25	-	-	0,01	0,01	18 / 25
Immigration Status	TIMSS 8	Student	BS4GBORN	Student BORN IN <COUNTRY>	-	-	1,4	1,3	-	-	-	-	-	-	-	0,01	0,03	20 / 25	-	-	0,01	0,03	22 / 25
Immigration Status	TIMSS 8	Student	BS4GBRNC	Student BORN IN <COUNTRY>\AGE OF COMING	-	-	3,7	5,1	-	-	-	-	-	-	-	0,01	0,02	7 / 25	-	-	0,01	0,03	8 / 25

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M4 = Interquartile range of % of missing data not including unit-non-response
C1 = Median Pearson correlation coefficient
C2 = Interquartile range of Pearson correlation coefficient
R1 = Median of explained variance in simple linear regression model
R2 = Interquartile range of of explained variance in simple linear regression model
R3 = Proportion of countries with significant relationship in simple linear regression model
- = Analysis type not applicable

Table A.13 Analysis results for language use at home

				Subject	Not Subject related				Reading					Math					Science				
Concept	**Study**	**Respondent**	**Item**	**Item Content**	**M1**	**M2**	**M3**	**M4**	**C1**	**C2**	**R1**	**R2**	**R3**	**C1**	**C2**	**R1**	**R2**	**R3**	**C1**	**C2**	**R1**	**R2**	**R3**
Language	PIRLS	Student	ASBGLNGH	Language	-	-	5,2	8,1	0,09	0,11	0,01	0,01	19 / 24	-	-	-	-	-	-	-	-	-	-
Language	PIRLS	Parents	ASBHLAHF	Language spoken by father	14,9	17,1	-	-	-	-	0,01	0,02	18 / 24	-	-	-	-	-	-	-	-	-	-
Language	PIRLS	Parents	ASBHLAHM	Language spoken by mother	13,5	19,0	-	-	-	-	0,01	0,02	20 / 24	-	-	-	-	-	-	-	-	-	-
Language	PIRLS	Parents	ASBHCHBL	Language of books	7,6	11,8	2,1	1,4	-	-	0,00	0,00	8 / 24	-	-	-	-	-	-	-	-	-	-
Language	TIMSS 4	Student	AS4GOLAN	OFTEN SPEAK <LANGUA OF TEST> AT HOME	-	-	0,9	1,4	-	-	-	-	-	0,13	0,11	0,02	0,03	21 / 25	0,18	0,16	0,03	0,06	21 / 25
Language	PISA	Student	ST12Q01	Language spoken at home	-	-	2,3	2,1	-	-	0,01	0,02	22 / 24	-	-	0,00	0,02	18 / 25	-	-	0,01	0,03	16 / 25
Language	TIMSS 8	Student	BS4GOLAN	OFTEN SPEAK <LANGUA OF TEST> AT HOME	-	-	0,5	1,1	-	-	-	-	-	0,08	0,13	0,01	0,02	17 / 25	0,10	0,14	0,01	0,04	18 / 25

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M4 = Interquartile range of % of missing data not including unit-non-response
C1 = Median Pearson correlation coefficient
C2 = Interquartile range of Pearson correlation coefficient
R1 = Median of explained variance in simple linear regression model
R2 = Interquartile range of of explained variance in simple linear regression model
R3 = Proportion of countries with significant relationship in simple linear regression model
- = Analysis type not applicable

Table A.14 Analysis results for occupation

				Subject	Not Subject related				Reading					Math					Science				
Concept	**Study**	**Respondent**	**Item**	**Item Content**	**M1**	**M2**	**M3**	**M4**	**C1**	**C2**	**R1**	**R2**	**R3**	**C1**	**C2**	**R1**	**R2**	**R3**	**C1**	**C2**	**R1**	**R2**	**R3**
Occupation	PIRLS	Parents	ASBHEMPF	Father's employment situation	11,8	13,9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Occupation	PIRLS	Parents	ASBHEMPM	Mother's employment situation	12,5	24,1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Occupation	PIRLS	Parents	ASDHPEMP	Parents' employment situation	13,8	24,1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Occupation	PIRLS	Parents	ASBHMJF	Father's main job	14,2	14,9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Occupation	PIRLS	Parents	ASBHMJM	Mother's main job	14,8	16,2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Occupation	PIRLS	Parents	ASDHOCCP	Parents' main job	8,5	13,8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Occupation	PIRLS	Parents	ASBHWELL	Family financially well-off	7,2	14,4	-	-	0,11	0,09	0,01	0,02	23 / 24	-	-	-	-	-	-	-	-	-	-
Occupation	PISA	Student	BMMJ	Occupational status Mother (SEI)	-	-	23,0	21,7	0,24	0,11	0,06	0,05	24 / 24	0,27	0,12	0,07	0,07	24 / 25	0,25	0,12	0,06	0,06	25 / 25
Occupation	PISA	Student	BFMJ	Occupational status Father (SEI)	-	-	11,3	7,5	0,27	0,07	0,07	0,04	24 / 24	0,28	0,09	0,08	0,05	25 / 25	0,28	0,08	0,08	0,04	25 / 25
Occupation	PISA	Student	HISEI	Highest parental occupational status (SEI)	-	-	4,9	4,0	0,29	0,08	0,08	0,05	24 / 24	0,31	0,08	0,10	0,05	25 / 25	0,30	0,08	0,09	0,05	25 / 25
Occupation	PISA	Student	MSECATEG	Mother White collar/Blue collar classification	-	-	23,1	21,5	0,21	0,12	0,04	0,05	24 / 24	0,23	0,14	0,05	0,06	25 / 25	0,22	0,12	0,05	0,05	25 / 25
Occupation	PISA	Student	FSECATEG	Father White collar/Blue collar classification	-	-	11,5	7,2	0,23	0,05	0,05	0,02	24 / 24	0,25	0,05	0,06	0,03	25 / 25	0,24	0,07	0,06	0,03	25 / 25
Occupation	PISA	Student	HSECATEG	Highest parent White collar/Blue collar classification	-	-	5,2	3,6	0,23	0,09	0,05	0,04	24 / 24	0,25	0,11	0,06	0,06	25 / 25	0,25	0,09	0,06	0,05	25 / 25
Occupation	PISA	Parents	PA15Q01	Household income	13,3	16,0	-	-	0,23	0,06	0,05	0,02	6 / 6	0,27	0,06	0,07	0,03	6 / 6	0,23	0,03	0,05	0,02	6 / 6
Occupation	PISA	Parents	PQBMMJ	Occupation of mother	39,3	27,0	-	-	0,22	0,12	0,05	0,06	7 / 7	0,22	0,13	0,05	0,07	7 / 7	0,23	0,16	0,05	0,08	7 / 7
Occupation	PISA	Parents	PQBFMJ	Occupation of father	17,5	8,5	-	-	0,24	0,06	0,06	0,03	7 / 7	0,23	0,08	0,05	0,04	7 / 7	0,24	0,07	0,06	0,04	7 / 7
Occupation	PISA	Parents	PQHISEI	Occupation of parents	12,8	5,3	-	-	0,26	0,05	0,07	0,03	7 / 7	0,27	0,09	0,08	0,05	7 / 7	0,29	0,09	0,08	0,05	7 / 7

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M4 = Interquartile range of % of missing data not including unit-non-response
C1 = Median Pearson correlation coefficient
C2 = Interquartile range of Pearson correlation coefficient
R1 = Median of explained variance in simple linear regression model
R2 = Interquartile range of of explained variance in simple linear regression model
R3 = Proportion of countries with significant relationship in simple linear regression model
- = Analysis type not applicable

Table A.15 Analysis results for derived scales and indices

PIRLS	Early Home Literacy Activities (EHLA)	-	-	6,8	12,1	0,67	0,09	0,15	0,07	0,02	0,02	24 / 24	-	-	-	-	-	-	-	-	-	-
PISA	Cultural Possessions (CULTPOSS)	1,3	1,9	-	-	0,60	0,09	0,26	0,12	0,07	0,07	23 / 24	0,23	0,12	0,05	0,05	24 / 25	0,26	0,09	0,07	0,05	24 / 25
PISA	Home Educational Resources (HEDRES)	0,5	0,6	-	-	0,56	0,14	0,27	0,09	0,07	0,05	24 / 24	0,27	0,13	0,08	0,07	25 / 25	0,27	0,12	0,07	0,07	25 / 25
PISA	Home Possessions (HOMEPOS)	0,3	0,3	-	-	0,75	0,10	0,28	0,10	0,08	0,05	24 / 24	0,29	0,12	0,09	0,07	25 / 25	0,29	0,12	0,08	0,07	25 / 25
PISA	Family Wealth Possessions (WEALTH)	0,3	0,3	-	-	0,64	0,14	0,12	0,18	0,02	0,05	21 / 24	0,18	0,17	0,03	0,06	23 / 25	0,15	0,18	0,02	0,05	23 / 25
PISA	Index of Economic, Social and Cultural Status (ESCS)	0,4	0,8	-	-	0,69	0,13	0,33	0,08	0,11	0,05	24 / 24	0,36	0,09	0,13	0,07	25 / 25	0,34	0,09	0,11	0,06	25 / 25

M1 = Median % of missing data including unit-non-response
M2 = Interquartile range of % of missing data including unit-non-response
M3 = Median % of missing data not including unit-non-response
M4 = Interquartile range of % of missing data not including unit-non-response
C1 = Median Pearson correlation coefficient
C2 = Interquartile range of Pearson correlation coefficient
Rel1 = Median reliability (Cronbach's Alpha) of scale/index
Rel2 = Interquartile range of reliability (Cronbach's Alpha) of scale/index
R1 = Median of explained variance in simple linear regression model
R2 = Interquartile range of of explained variance in simple linear regression model
R3 = Proportion of countries with significant relationship in simple linear regression model
- = Analysis type not applicable