

Measurement invariance of socioeconomic status across migrational background

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Socioeconomic status (SES) is often measured in educational research where students' family background frequently is used as a control variable. This is, for example, desirable when relations between academic outcomes and students' migrational background are investigated, because of the correlation between SES and migrational background that is typically observed. However, when measuring SES, the indicators used must have the same meaning and structure for different migrational groups. The aim of this study is to examine the measurement invariance of the SES construct across diverse student groups, using data from Trends in International Mathematics and Science Study, TIMSS, 2003. The findings reject the hypothesis of equivalent measurement structure of SES across subpopulations with Swedish and non-Swedish background. In this paper an alternative model for description and analysis of SES is proposed, in which indicators are modified according to students' migrational background.

Keywords: socioeconomic status, migrational background, measurement invariance

Introduction

Most countries are undergoing considerable demographic changes through continuous international migration, with ethnic and linguistic diversity in the school as a consequence (D. Coleman, 2006; OECD, 2003). The students' linguistic background affects academic outcomes, and the SES of the family is another significant factor (Grouws, 1992). The mutual relation between these two factors is complex (Fernandez & Nielsen, 1986; Rosenthal, Baker, & Ginsburg, 1983) and to avoid erroneous conclusions, it is important to pay regard to the influence from both these background factors. When just language is used for capturing student background, effects may be confounded with SES. Using just SES could on the other hand hide the influence from students' linguistic backgrounds.

Minority groups with foreign background have weaker school performance than their majority peers (Skolverket, 2009) and in order to analyze what causes this diversity, valid methods to capture the SES construct are required. One important question to ask is if the indicators used in models for describing and analyzing SES function in the same way for minority and majority students? It may, for example, be the case that the indicator parental education has a different meaning for a student born and raised in Sweden, than it has for a student who has recently arrived in Sweden from a country in which the level of education is considerably lower than in Sweden. In this study a model is developed to investigate the measurement invariance of SES over different migrational groups, and possible consequences of lack of measurement invariance. The model was developed by first conducting a test of factorial and measurement invariance across multiple groups and further using this result when elaborating the SES model. Data from TIMSS 2003, 8th grade, are used in the test of measurement invariance and when validating the finally developed SES-model are. Sweden is in this study used as an example.

Background

The individual background factor SES, family socioeconomic status, is in educational research often used as a control variable in investigations of factors influencing students' academic outcomes, because there is an empirically established relationship between academic outcomes and SES (J. S. Coleman, et al., 1966; Jencks, et al., 1972; Shavit & Blossfeld, 1993; Sirin, 2005). SES has for example been shown to influence the framing of children's education by choice of school and course of study, which in turn is important for the level of academic achievement (Breen & Jonsson, 2005).

The relationship between students' academic outcomes and SES is around 0.30 at the individual level and at the class level it is around 0.60-0.80 (Gustafsson, 1998; White, 1982). A slight decrease in the correlation between SES and achievement has been observed internationally the last decades (Sirin, 2005), but in Sweden the correlation has increased, and schools have become more homogenous with respect to students' social and migrational background (Gustafsson & Yang, 2009). The differences in outcomes have also increased between schools and between different groups of students during the same period. Parental educational level also has become more significant for students' achievements.

Sirin (2005) concluded that of all the factors examined in the meta-analytic literature, family SES at the student level is one of the strongest correlates of academic performance, and the school level the correlations are even stronger. Parents' location in the socioeconomic structure thus has a strong impact on students' academic achievements and sets the stage for students' academic performances, both by directly providing resources at home and by indirectly providing the social capital that is necessary to succeed in school (J. S. Coleman, 1988).

In general terms, SES can be described as an individual's or a family's position in a hierarchy according to access of wealth, power and social status (Mueller & Parcel, 1981). Duncan, Featherman and Duncan (1972) identified three different aspects of SES, parental income, parental education and parental occupation, all treated as a one-dimensional single entity of home characteristics. To more richly interpret effects of SES on student's academic achievement, different aspects of these home-characteristics, such as economic, cultural and social dimensions, can be identified (Yang & Gustafsson, 2004). The theoretical approaches to conceptualize SES which have influenced this study, are in particular Bourdieu's (1984) and Coleman's (1988) concepts of cultural, economic and social capitals and networks. According to Bourdieu (1984), the family capital can take three fundamental and interrelated shapes, namely cultural, economic and social capital. With cultural capital is meant that more privileged families for example possess a kind of capital congruent with the symbolic and social expectations of the existing education system. Cultural capital has been shown to be the most important factor to affect student's achievements (Yang & Gustafsson, 2004). In cross-national studies SES has also been shown to be multi-dimensional, which dimensions are differentially related to academic outcomes and measured by different variables in different countries (Yang, 2003; Yang & Gustafsson, 2004).

Also within countries, students' experiences could be influenced by cultural and language differences, and by migration experience, and this could influence the measurement of SES. When student SES is used as a control variable, for example, the indicators used in the measurement must have comparable meaning across the subpopulations being compared.

Elmeroth (2006) argues that variables indicating SES could have different meanings and structures in groups with different migrational background, and that this may influence the validity of some frequently used indicators.

Parental education is often used as an indicator of SES, and is considered to be one of the most stable aspects of SES because it is typically established at an early age and tends to remain the same over time (Sirin, 2005). However, the meaning of having a low or a high education could vary between the students' country of origin and it could be that this variation remains also after the immigration.

In Sweden, the parental educational level tends to be of lower importance for the academic performance of students with foreign background compared to Swedish students (Elmeroth, 2006; Skolverket, 2004a). There are substantial differences in level of parental education for students with different migrational background: for students with foreign background, 19 % of the parents have at most secondary-school education, while for students with Swedish background 5 % have (Elmeroth, 2006). These differences could also reflect the differences in educational levels between countries. Thus, as an indicator in a model for describing and analyzing SES, parental education may not have the same meaning for all students. For different countries, the levels of, and relations between fathers' and mothers' educations vary (UNESCO, 2001), and thus the measurement validity of the SES construct could be affected when using parental education as an indicator.

Parental education is also related to parents' income because income and education are highly correlated in most OECD countries. In Sweden, however, this correlation is smaller than in most OECD-countries (OECD, 2007). Parental income anyway reflects the potential for social and economic resources available to the student.

Occupation is related to both education and income, and as indicator of SES it could produce information about the social status of a household, in that it also represents information about the prestige and culture of a given socioeconomic level (Sirin, 2005). However, the agreement between educational level and occupation is different for persons born within a country and those born abroad (Rooth & Åslund, 2005). In Sweden the agreement is stronger for people with foreign backgrounds, and this too could impact negatively on the validity of the measurement.

Another often applied indicator is *home resources*, for example the number of books in the student's home. This indicator too is in agreement with Bourdieu's theory concerning cultural capital as a marker for privileged families. In the national evaluation of the compulsory school in Sweden 2003 (Skolverket, 2004b), this indicator showed great differences between students with foreign background and Swedish students. Less than 50 books at home were reported by 40% of the students with foreign background, and by 16 % of the Swedish students. This difference is likely to reflect not only families' educational backgrounds or social status, but can also be an effect of the families' migration (Elmeroth, 2006). The indicator is, furthermore, more highly related to achievement for Swedish students than for students with foreign backgrounds (Elmeroth, 2006).

Students' *educational aspirations* can reflect family SES (Goldstein-Kyaga, 1995; Skolverket, 2004a). Educational ambitions are related to family background, and academic achievement also is related to family SES. Students' attitudes towards school, performance and educational aspirations also are associated to each other (Linnakylä & Malin, 2008), but in a mutual relation where performances impact on the formation of educational aspirations, and the aspirations have impact on student's academic outcomes (Marjoribanks, 2003). These relations have also been shown to differ between ethnic groups. The meaning of aspirations also differs between groups of students. For example, aspirations for students with foreign background are strongly related to a chance of getting a better position in life (Lundqvist, 2005), because to succeed with their studies could be the only way to entrance on the labor market (Knocke & Hertzberg, 2000). Students with foreign backgrounds tend to have high educational aspirations (Bons, 2003; Ljung, 2000), but the family's cultural capital is of greater importance for these students' choice of further university studies than it is for the Swedish students (Ljung, 2000). When both parents in families with foreign background lack higher education they give less encouragement for university studies to their children than Swedish families in the same situation do. In families with educational traditions however, this encouragement is more apparent in families with foreign background than it is for Swedish students. Educational aspirations thus seem to be related to both social and ethnic backgrounds.

Items used as indicators of the cultural capital dimension of SES are in many of the studies referred above shown to represent different meanings for different groups of students. In a study by Braveman, et al. (2005) it is discussed if associations between ethnic groups and academic outcome can be influenced by the measurement used for SES. Questions concerning the comparability of individuals with similar indicator levels were raised in the study, since differences in meaning and level of indicators were noted between groups: "Whenever possible, researchers should examine how findings using a given SES measure vary across social groups" (p. 2885). Stewart and Napoles-Springerstates (2003) similarly claim: "The finding that relationships of race/ethnicity and health vary within SES levels could be in part because commonly used SES measures are not similarly interpreted across racial/ethnic groups" (p. 1209). More research is required to better understand underlying reasons for group differences in different aspects of the SES construct. It is of importance to explain students' educational performances from a multi-cultural perspective. However, if ethnocentric variables are used for description and explanation, the meaning of background factors will not fully be clarified in the research, and use of such biased procedures could be regarded as a structural discrimination within the educational system (Cummins, 1979).

To sum up, previous research has established a relationship between students' academic outcomes and family socioeconomic status, SES, and the nature of this relation has also been shown to be related to students' ethnic and migrational backgrounds. The strength of the relationship not only depends on demographic differences, but also on the opportunity of choosing school and educational groups, on the nature of the data and also on the way in which social background is measured. This makes it important to further examine and improve the measurement of the individual background factor SES. Most measures focus on individual-level variables such as income and education, however, research increasingly finds that aggregate or area-based SES indicators contribute to

explained variance over and above individual factors (Stewart & Napoles-Springer, 2003). The SES construct is to be viewed as multi-dimensional, and the most important dimension to affect students' achievements has been shown to be the cultural capital dimension. Finally, the meaning of commonly used indicators and their relations to academic outcomes has been shown to be complex. Indicators concerning parental education, families' possession of books and students' educational aspirations could carry different meanings due to students' migrational experiences. For explaining school performances these indicators also have been shown to have different significance for students with Swedish and foreign backgrounds.

Family background indicators such as parental education, income and occupation have in previous research, for example in the meta study by Sirin (2005), been shown to be less predictive for minorities. However, the validity of those findings could be questioned, if the measurement of SES is biased. The indicators' meaning and structure when measuring SES could be different for different groups of students. But the question how to measure SES in heterogeneous groups has not been answered in previous research. This is an important field of investigation.

In this study it is hypothesized that the measurement of SES is significantly influenced by group differences. Using an ordinary set of indicators the study examines the factorial invariance for the SES construct for groups of students with different migrational backgrounds.

Research settings and method

The main question in the present study thus is if the structure of measurement of SES is equivalent across groups of students with diverse cultural and linguistic backgrounds. The validity of the measurement of SES was hypothesized to be significantly influenced by group differences with respect to migrational background.

A latent variable model of SES was hypothesized. First a test of factorial and measurement invariance across multiple groups with diverse linguistic backgrounds was conducted, and the results from this step were then used to elaborate the SES model to take group differences in measurement properties into account. Data from the Swedish 8th grade students in TIMSS 2003 were used in the empirical study.

In the presented theoretical review some aspects of the measurement SES was treated. One was the conceptualization of the construct and another concerned items used to indicate this construct. In this study SES will be treated as a theoretically founded latent construct, and a reflective measurement model will thus be used. The conceptualization of SES decides the selection of indicators for the model, and the indicators are to be viewed as caused by the construct and should correlate with each other in meaning.

Data Sources

The data source for the empirical study was the Trends in International Mathematics and Science Study (TIMSS 2003) conducted by the International Association for the Evaluation of Educational Achievement (IEA), focusing on mathematics for Swedish students in 8th grade, with 4 256 students from 274 classes in 160 schools. The contextual variables were derived from the student questionnaire. In the data subset used, only classes with one mathematics teacher were included (253 classes). After listwise deletion, there were 3233 observations left in 217 classes with an average cluster size of 15.15. For items used in the analysis, see Table 1.

Latent variable analysis through Confirmatory Factor Analysis

Confirmatory Factor Analysis (CFA) requires a strong empirical or conceptual foundation to guide the specification and evaluation of the factor model (Brown, 2006). In a first step a one-level Multiple Groups CFA approach with one latent factor was adopted for the measurement model and the Mplus (Muthén & Muthén, 1998) and STREAMS (Gustafsson & Stahl, 2004) software was applied in the analyses'. The latent factor was indicated by four items from the student questionnaire, see Table 1. Students in the TIMSS study responded to the questions "About how many books are there in your

home”, “What is the highest level of education completed by your mother/father” and “How far in school do you expect to go”. Responses were indicated on a 5-9-point Likert scale.

Several indices were used to assess overall model fit: *the chi-square test, the root-mean-square error of approximation (RMSEA), the comparative fit index (CFI) and the standardized root mean-square residual (SRMR)* (Brown, 2006). RMSEA values less than 0.05 represent a “close fit”, and models with values above 0.08 should be rejected. For CFI a value of at least 0.95 is required to accept a model. The SRMR was used as an absolute fit index, and should be 0.08 or less. Because the chi-square statistic is very sensitive to sample size, chi-square/df ratio was also examined to check fit (Kline, 1998).

Table 1: List of Items used in the CFA, Within(individual)- and Between(class)-level

<i>Item</i>	<i>Score</i>
(BSBG)BOOK; <i>About how many books are there in your home?(Do not count magazines, newspapers, or your school books.)</i>	<i>None or very few (0-10 books): 1, Enough to fill one shelf (11-25 books): 2, Enough to fill one bookcase (26-100 books): 3, Enough to fill two bookcases (101-200 books): 4, Enough to fill three or more bookcases (more than 200 books): 5.</i>
(BSBG)MFED; <i>What is the highest level of education completed by your mother (or stepmother or female guardian)?</i>	<i>Did not complete upper secondary school: 1, 6 year in compulsory school: 2, 9 year in compulsory school: 3, Upper secondary school: 4, Vocational supplementary education, other than university education: 5, Degree from undergraduate university education: 6, Master’s degree or other higher degree: 7. I do not know: 8</i>
(BSBG)FMED; <i>What is the highest level of education completed by your mother (or stepmother or female guardian)?</i>	<i>Did not complete upper secondary school: 1, 6 year in compulsory school: 2, 9 year in compulsory school: 3, Upper secondary school: 4, Vocational supplementary education, other than university education: 5, Degree from undergraduate university education: 6, Master’s degree or other higher degree: 7. I do not know: 8</i>
(BSBG)HFSG; <i>How far in school do you expect to go?</i>	<i>Upper secondary school: 1, Vocational supplementary education, other than university education: 2, Degree from undergraduate university education: 3, Studies beyond undergraduate university education: 4, I do not know: 5.</i>
(BSM)STDR <i>Standardized Mathematic Raw Score</i>	<i>Student achievement scores in mathematics, standardized.</i>

Multiple-Groups CFA

With Multiple-Groups CFA (Brown, 2006) it is possible to simultaneously conduct an analysis of more than one group, when examining the equivalence of all measurement and structural parameters of a factor model, that is, *measurement invariance* and *population heterogeneity*.

The *tests of measurement invariance* evaluate the equivalence across groups (students with foreign background and Swedish students) of the parameters of the measurement model: factor loadings, intercepts and residual variances.

The *tests of population heterogeneity* evaluate if the dispersion, interrelationships and levels of the latent factors vary across groups. Structural parameters of the CFA model are factor variances, covariances and latent means. The analysis of mean structures is here designed to evaluate the equality of latent means.

The basic question in this study thus is if the items used have the same meaning when measuring the construct SES, or if there are group differences that prevent students to respond to the questionnaire in comparable ways? To answer this question, CFA with multiple groups can be used (Brown, 2006). The *test of measurement invariance* is conducted in steps 1-4, and the *test of population heterogeneity* is conducted in steps 5-6 described below (Brown, 2006).

Tests of measurement invariance:

- **Step 1. *Test of equal form.*** Are the number of factors and the patterns of indicator-factor loadings identical across groups?
- **Step 2. *Test of equal factor loadings.*** Are the factor loadings of the indicators equivalent across groups? This test determines whether the measures can be regarded as having the same meaning and structure for different groups of respondents or not.

- Step 3. Test of equal indicator intercepts. Are the levels of the indicator intercepts equivalent in the groups?
- Step 4. Test of indicator residual variance. Are the indicator residual variances equivalent across groups? This step is in this study however not conducted, since it in applied research is extremely rare that the residual variances are similar for different groups (Brown, 2006). To predict by means of a latent variable model, that different groups have equal observed values of the indicators, is not dependent on the error variances for all groups being equal.

Test of population heterogeneity:

- Step 5. Test of the equality of factor variances. Do the factor variances vary across groups? Factor loadings are required to be equal for all groups when conducting this step of the analysis.
- Step 6. Test of the equality of latent means. Do the levels of the latent factors vary across groups. Both indicator factor loadings and intercept are required to be equal for all groups when conducting this step of the analysis.

In the next step the results from this Multiple-Groups CFA were applied for conducting a robustness test which investigated the sensitivity of the CFA-model.

Robustness test, M-CFA

By investigating if effects from some indicators are situated in the latent factor or in the structural differences of the indicators between groups, the sensitivity of the measurement was analyzed by conducting a robustness test. Comparisons were made between two measurement models, where one was modified for significant group differences with respect to meaning and structure of the indicators used. Aspects compared were model fit, characteristics of the measurement model, and the explained variance in students' scores on the achievement test.

Hypothesized measurement model for SES

The aspect of SES focused on was the family cultural capital, that in previous research has been shown to be most strongly related to academic achievement (Yang & Gustafsson, 2004). It was, furthermore, hypothesized that the validity of the measurement of SES would be influenced by group differences related to migrational background within the inquiry group (Bons, 2003; Elmeroth, 2006; Ljung, 2000; Lundqvist, 2005; Sirin, 2005; Skolverket, 2004b). Thus, the factorial invariance for three groups of students was examined, G1: students with foreign background born outside Sweden, G2: students with foreign background born within Sweden and G3: students with Swedish background. With foreign background is meant that both parents were born in another country than Sweden or that the student was born outside of Sweden (Skolverket, 2004a).

The reason for subdividing students into these groups is the significance for measurement invariance of migrational effects and time spent in the new country. Levels and meanings of common indicators of SES could vary between groups of students, not only in relation to the families' socioeconomic background, but also to their migrational experiences (Elmeroth, 2006; Goldstein-Kyaga, 1995; Lundqvist, 2005; Rooth & Åslund, 2005; Sirin, 2005; Skolverket, 2004a, 2004b, 2005).

In order to develop a measurement model of SES, the theoretical starting-points for latent factors and appropriate indicators were first made explicit. It was hypothesized that a dimension of SES characterizing homes to be educationally oriented and supportive of student's academic achievements, reflects the family cultural capital (Bourdieu, 1984; J. S. Coleman, 1988; Yang & Gustafsson, 2004). This dimension was represented by the latent factor labeled SES-c.

A set of items from the student background questionnaire in TIMSS 2003, 8th grade was used as indicators, see Table 1. Four observed variables were chosen to indicate this latent factor, namely BOOK (*About how many books are there in your home?*), MFED (*What is the highest level of education completed by your mother?*), FMED (*What is the highest level of education completed by your father?*), and HFSG (*How far in school do you expect to go?*). The hypothesized SES-model is shown in figure 1.

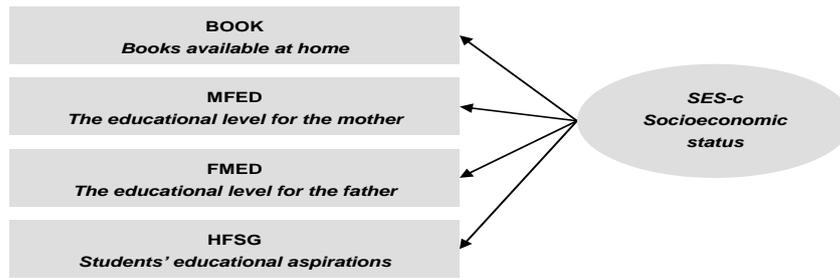


Figure 1. The measurement model for socioeconomic status, SES

The item BOOK indicates the kind of family capital congruent with the symbolic and social expectations of the existing education system. The indicator shows great differences between students with foreign background and Swedish students (Skolverket, 2004b), which presumably is related to family educational backgrounds or other aspects of status, and also to different effects from the families' migration (Elmeroth, 2006).

The items MFED and FMED are two other indicators of SES-c. *Parental education* is an often used indicator of SES but the importance of this indicator for students' academic performances is shown to vary between groups (Elmeroth, 2006; Sirin, 2005; Skolverket, 2004a).

The item HFSG is another indicator which has a well established relation to SES and cultural capital (Goldstein-Kyaga, 1995; Skolverket, 2004a). Student performance and educational aspirations are also associated to each other (Linnakylä & Malin, 2008; Marjoribanks, 2003). However, these relations have been shown to be complex, where both meaning and level differ between ethnic groups (Bons, 2003; Ljung, 2000; Lundqvist, 2005). Educational aspirations thus seem to be related to both social and ethnic background.

Results

Below the results of the different steps of modeling are described.

The Multiple-group test

In the first step of analysis it was investigated if the hypothesized one-factor model fitted the data from each of the three groups, and it was concluded that the proposed model fitted the data of the three student groups in a satisfactory way. In the next step tests were made of measurement invariance over groups, and the results from each step in the analysis are described below. The discrepancy of group sizes are taken into consideration¹, since the interpretation of the analysis is more complex for varying group sizes (Brown, 2006).

Test of equal form

In this step it was tested if the number of factors and pattern of indicator-factor loadings were identical across groups. The proposed SES model was shown to reflect the socioeconomic status in all student groups, G1, G2 and G3, in a satisfactory way. The deviations between the observed data and the models were all insignificant, see Table 2. It was however indicated that the power of explanation of the achievements varied between groups. It was also stated that the four indicators could have different meanings for the different student groups. These results served as a baseline model for subsequent test of measurement invariance.

Table 2. Test of Measurement invariance of SES in G1, G2 and G3.
STEP 1; Test of equal form, *Model fit*.

¹ G1: N=267, G2: N=258, G3: N=2708

	χ^2	df	RMSEA 90% CI Root mean square error of approximation	SRMR Standardized Root mean square residual	CFI Comparative fit index	TLI Tucker- Lewis Index
G1, G2 & G3	10.792 12.59 *	6	0.027	0.016	0.995	0.986

G1= Students with foreign background born outside Sweden, G2= Students with foreign background born in Sweden, G3=Swedish students. *) Critical value

Test of equal factor loadings

In this step it was evaluated if the factor loadings of the indicators were equivalent in the three groups. When restrictions on factor loadings were put into the models, which forms the assumption that the indicators have the equivalent meanings for all groups of students, no significant impairment of the model fits came up for most of the indicators, see Table 3. When restrictions were put on the factor loadings for the indicator MFED (the educational level for the mother) a slightly worse fit was observed. The meaning of this indicator differs slightly between students with foreign background born outside Sweden and students with Swedish background. However, except from this indicator, it may be concluded that the indicators used in the SES-model do have the same meaning for all students in the inquiry.

Table 3. Test of Measurement invariance of SES in G1, G2 and G3.
STEP 2; Test of Equal factor loadings, *Model fit*

	χ^2	χ^2_{diff}	χ^2_{diff}	χ^2_{diff}	χ^2_{diff}	χ^2_{diff}
		Nested χ diff				
	<i>Equal form</i>	<i>Equal factor loadings_ HFSG</i>	<i>Equal factor loadings_ FMED</i>	<i>Equal factor loadings_ MFED</i>	<i>Equal factor loadings_ BOOK</i>	<i>Equal factor loadings_ all indic.</i>
G2 & G3	6.815 9,49*	-0,013 3,84*	0,768 3,84*	2,656 3,84*	-0,021 3,84*	4,855 7,82*
G1 & G3	9.441 9,49*	1,838 3,84*	2,715 3,84*	6,742 3,84*	1,839 3,84*	19,083 7,82*
G1 & G2	5.466 9,49*	0,846 3,84*	0,139 3,84*	0,28 3,84*	0,612 3,84*	1,969 7,82*
G1, G2 & G3	10.792 12,59*	1,647 5,99	3,214 5,99*	8,465 5,99*	1,649 5,99*	21,953 12,59*

G1= Students with foreign background born outside Sweden, G2= Students with foreign background born in Sweden, G3=Swedish students. *) Critical value

Test of equal indicator intercepts

In this step it was investigated whether the levels of the indicator intercepts were equivalent over the three groups. When restrictions on factor intercepts were put into the models, which tests the assumption that the indicators have the equivalent levels for all groups of students, a significant impairment of the model fits came up (see Table 4).

The largest decrease of model fit arose when restrictions were put on the indicator BOOK. The level of the indicator was significantly different between all groups of students. The largest difference was between students with foreign background born outside Sweden, G1, and the Swedish students, G3. It thus could be stated that the amount of books available at students homes are so different in the three student groups in the inquiry, that the differences cannot be accounted for by the latent variable SES-c.

The second biggest influence on the model fit derived from the indicator MFED. The level of this indicator differed between student groups in a way that significantly impaired the model fit when the mean value of mothers educational levels were supposed to be equal in all groups. The largest difference for this indicator was also observed between G1 and G3. However, between students with

foreign background born within Sweden and those born outside Sweden, the differences were so small that they did not influence the model fit.

The third biggest influence on the model fit derived from the indicator HFSG. The level of this indicator differed between student groups in a way that significantly impaired the model fit when the mean value of students educational aspirations were supposed to be equal in all groups. The largest difference was again between G1 and G3, and the differences between G1 and G2 were too small to influence the model fit. Finally, the different levels of the indicator FMED did not have any impact on the model fit in this test.

Table 4. Test of Measurement invariance of SES in G1, G2 and G3.

STEP 3; Test of Equal indicator intercept, *Model fit*

	χ^2 value for <i>Equal</i> <i>factor</i> <i>loadings</i> <i>(for all</i> <i>indicators):</i>	χ^2_{diff} Nested χ diff <i>Restricted</i> <i>for HFSG</i>	χ^2_{diff} Nested χ diff <i>Restricted</i> <i>for FMED</i>	χ^2_{diff} Nested χ diff <i>Restricted</i> <i>for MFED</i>	χ^2_{diff} Nested χ diff <i>Restricted</i> <i>for BOOK</i>	χ^2_{diff} Nested χ diff <i>Restricted</i> <i>for all indic.</i>	χ^2_{diff} Nested χ diff <i>Restricted</i> <i>for STDR</i>
G2 & G3	11.670	5,738 3,84*	0,467 3,84*	14,483 3,84*	97,539 3,84*	141,568 9,49*	
G2 & G3 (STDR incl.)	89.728	7,35 3,84*	0,300 3,84*	14,160 3,84*	105,048 3,84*	188,619 3,84*	47,815 11,07*
G1 & G3	28.524	13,399 3,84*	0,809 3,84*	17,175 3,84*	177,519 3,84*	239,12 9,49*	
G1 & G3 (STDR incl.)	121.119	14,722 3,84*	0,484 3,84*	15,905 3,84*	123,254 3,84*	352,92 11,07*	123,254 3,84*
G1 & G2	7.435	1,285 3,84*	1,07 3,84*	0,249 3,84*	5,723 3,84*	10,731 9,49*	
G1 & G2 (STDR incl.)	24.960	1,24 3,84*	0,885 3,84*	0,185 3,84*	6,119 3,84*	20,605 11,07*	0,185 3,84*

G1= Students with foreign background born outside Sweden, G2= Students with foreign background born in Sweden, G3=Swedish students. *) Critical value

Test of the equality of factor variances

In this step it was tested if the factor variances varied across groups. In applied research it is somewhat unclear which questions are answered by this step of the analysis (Brown, 2006), and thus it will just briefly be described that no significant differences of the factor variances between groups were evinced.

Test of the equality of latent means

As the indicator intercepts not were equal for all groups, this step of the analysis was not conducted.

Conclusions

To sum up, the results from step 3 in the Multiple-Groups CFA showed the proposed SES model to reflect the socioeconomic status in the three student groups in a satisfactory way. The indicators used in the SES-model do have the same meaning for the three groups of students in the inquiry. The indicator MFED, however, seemed in some sense to have varying meanings between groups. However, the levels of the indicator intercepts were not equivalent in the three groups, since restriction on these caused a significant impairment of the model fit. The largest deviations of model fit arose when restrictions were put on the indicators BOOK and MFED. The largest difference was shown between students with foreign background born outside Sweden, G1, and Swedish students, G3. These results show that that for the BOOK and MFED indicators there were mean differences between the groups over and above those accounted for by the latent SES-c variable.

The Robustness test

By using multiple group analysis, the tests of measurement invariance showed similarities across groups of most parameters of the measurement model, except from the intercepts of some indicators.

These deviations could, however, be handled in a one-group-model by using dummy variables. In the robustness test a one-group-model thus was worked out, and it was hypothesized that if the SES model is not modified for group differences of the levels for the indicators BOOK and MFED, it would become biased, which means that the effect of MFED and BOOK are not due to the latent factor SES-c, but to the indicators. It thus was investigated how measurement invariance affected model fit as well as the power of the latent variable to explain variation in achievement. The hypothesized model is shown in figure 2.

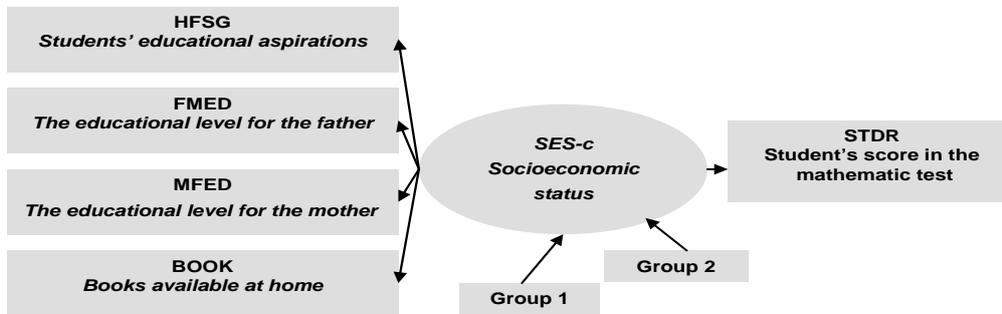


Figure 2. Hypothesized SES model with indicators from observed variables in the TIMSS-data, 2003 (student questionnaire)

In this model the groups were represented by two dummy variables, G1 and G2. The model with relations between the two dummy variables and SES-c had poor fit ($\chi^2 = 398.436$, $df = 8$, $RMSEA = 0.122$). According to this model the two groups with foreign background had a lower SES-c level than the group with Swedish background. When the dummy variables were allowed to influence the indicators BOOK and MFED directly, see figure 3, the model fit improved considerably (χ^2 improved from 398.436 to 18.489), table 5. Thus, in this modified model group differences in these two indicators are not allowed to influence the estimate of group differences in the mean SES-c level, and it may be noted that there were no significant group differences in SES-c according to this model. These results agree with those obtained in the multiple group tests, namely that there are differences in the levels of the indicators BOOK and MFED over groups.

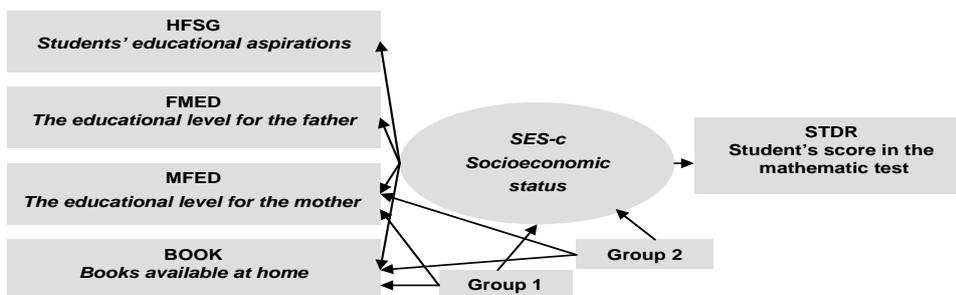


Figure 3. Hypothesized SES model with covariations between groups and indicators

Table 5. Test of the robustness of the measurement model of SES, modified for covariations between G1, G2, G3, latent factor, indicators and STDR, *Model fit*

Model	χ^2	df	RMSEA 90% CI Root mean square error of approxi- mation	SRMR Standar-dized Root mean square residual	CFI Compara- -tive fit index	TLI Tucker- Lewis Index
Not mod. model	19.673	2	0.052	0.020	0.982	0.947
Mod. for SES-c	398.436	8	0.122	0.065	0.750	0.531
Mod. for BOOK, MFED, SES-c	18.489	4	0.033	0.014	0.990	0.965
Mod. for BOOK,	107.282	7	0.066	0.028	0.953	0.865

MFED, STDR, SES-c
 Mod. for STDR, SES-c 518.862 11 0.118 0.064 0.760 0.563

Next the amount of variance explained by SES-c in achievement was compared for the unmodified and modified models. The unmodified model SES explained more variance than did the modified model (0.216 and 0.186, respectively; see table 6). If it also was modified for Achievement, which could be illustrated by arrows between groups and STDR, the explained variance in STDR increased (explained variance improved from 0.186 to 0.236). This could imply either the group differences in indicator levels to be related to Achievement which means that a modified SES model should explain more variance in Achievement, or the different group levels of Achievements to solely contribute to improved explanation of the variance in Achievements. This was subsequently investigated.

Table 6. Test of the robustness of the measurement model of SES, modified for covariations between G1, G2, G3, latent factor, indicators and STDR, *Explained variance*

Model	Explained variance				
	BOOK	MFED	FMED	HFSG	STDR
Not mod. model	0.315	0.542	0.490	0.376	0.216
Mod. for SES-c	0.388	0.523	0.429	0.305	0.239
Mod. for BOOK, MFED, SES-c	0.376	0.538	0.517	0.422	0.186
Mod. for BOOK, MFED, STDR, SES-c	0.376	0.528	0.509	0.453	0.236
Mod. for STDR, SES-c	0.349	0.545	0.467	0.342	0.234

The modification for BOOK and MFED was then excluded from the model, but the modification for Achievements remained. Both model fit and explained variance in Achievement were then examined, that is the robustness of the SES model. The model fit became impaired (χ^2 rose from 107.282 to 518.862), but the explained variance in Achievement remained mostly unchanged (altered from 0.236 to 0.234). It could thus be stated that almost no more variance in Achievements were explained when it was modified for group differences in the levels of the indicators BOOK and MFED, but the model fit was improved by the modification.

Conclusions and discussion

In this study it is investigated if the validity of the measurement of SES is influenced by group differences. Using a set of standard indicators for the construct SES, the factorial invariance for three groups of students (students with foreign background born outside Sweden, students with foreign background born within Sweden and students with Swedish background) was examined, with the aim to develop a model for description and analysis of SES with a multi-cultural perspective. The research question was if it is necessary to pay attention to group diversity to obtain a valid measurement model for SES or if such model is robust for this kind of influences. The model was developed by first conducting a test of factorial and measurement invariance across multiple groups and further using this result when elaborating the SES model. Data used in the test of measurement invariance and when validating the finally developed SES-model is Swedish data from 8th grade TIMSS 2003.

With limitations offered by the data, the selection of indicators for the measurement model of SES is theoretically founded to mirror family's cultural capital, which is shown to have the greatest influence on students' academic performances. In the multiple group analysis the results showed that group differences related to the indicators BOOK (the amount of books in students' home) and MFED (the educational level for the mother) of the latent factor SES-c were larger than could be accounted for by group differences in the construct itself. If these differences between students with foreign backgrounds and Swedish students were not taken into account, the SES-model could be biased. The number of books available for students with migrational backgrounds was significantly lower than for Swedish students, and which could be due to migrational effects, and not to the family cultural capital. When emigrating, the library probably was not included, and to obtain new books in the new country

could be limited by language difficulties. The educational levels for the mothers to students with foreign backgrounds were shown to be significantly lower than for the Swedish students' mothers. The fathers' educational levels however, were not different between groups. For students born outside Sweden, they are even higher than for Swedish students.

Even though the model fit became impaired by the different indicator structures, the explained variance in the students' scores in the mathematic test STDR, was not weakened by this group diversity. In that respect, the CFA measurement model must be viewed as robust. It could thus be stated that the proposed SES model does reflect the socioeconomic status in the three student groups in a satisfactory way, and the indicators used in the SES-model do have the same meanings for all students. But to modify for these group differences of the levels of the indicators could involve enhanced possibilities for researchers to interpret research findings, since the model fit will improve and sources of bias will be captured.

Possible further indicators, different from those relied upon in this study, could for example be the family income which is related to socioeconomic background (Sirin, 2005). Items concerning this indicator are however not available in the present data and family income in Sweden is less correlated to other indicators used in the model, as for example parental education, than in most OECD-countries (OECD, 2007). Parental occupation is another possible item to be used when indicating SES. This item is closely related to both education and economy and offers information concerning the family cultural status (Sirin, 2005). It should thus have been preferable to have access to items regarding this indicator. However, to obtain a valid measurement model it should probably be necessary to pay attention to group diversity for this indicator as well. (Rooth & Åslund, 2005).

Family background indicators have in previous research, for example in the meta study by Sirin (2005), been shown to be less predictive for minorities. Neighborhood and school SES, not family SES, may exert a more powerful effect on academic outcomes in minority communities. The starting point for these statements is however that the measurement of SES is not biased, that all estimated correlations do reflect the "true" relation. Due to findings in this study, group diversity of the structures of the indicators could affect the validity of measurement; there thus is reason to question the validity of some previous findings.

Many researchers tend to identify the causes for the unsatisfactory outcomes for students with foreign background among a range of individual background factors and more infrequently penetrate the importance of contextual factors (Elmeroth, 2006). Elmeroth emphasizes the need for taking both individual and contextual background factors into consideration in educational research. According to the theory of Bourdieu, minority language students run the risk of being discriminated within the education system since they lack means to acquire the particular cultural capital which is necessary in order to succeed in school (Robbins, 2005). Following Bourdieu's theory of cultural capital, social and academic language skills are vital in terms of the linguistic capital they represent, and there is a body of literature written from a linguistic human rights perspective concerning discrimination of minority language groups for example (Cummins, 2000; Galindo, 1997). Similarly to Elmeroth, Rendón (1999) emphasizes that the causes for this discrimination are to be found within contextual as well as individual background factors. The cultural capital of these students has to be confirmed and incorporated by the educational system, the author claims. These students do want a career, but the school system does not allow them succeed. To improve minority students' academic outcomes, Nowlan (2008) emphasizes the necessity for the educational system to be supportive for this group of students. Accordingly it could be established that families' socioeconomic and migrational background as well as contextual background factors are significant for explaining variations in academic outcomes, and the covariation between all those factors is an object of further research and discussion.

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