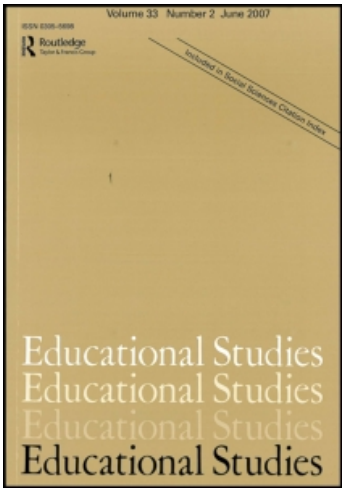

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Student background factors influencing student achievement in Serbia

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Student background factors influencing student achievement in Serbia

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This paper describes student-level findings of the first large-scale comprehensive school effectiveness study of the primary education in Serbia. Twenty-five student-level variables were examined in a three-level HLM model using a study sample of almost 5000 students, over 250 classrooms and over 100 schools. Differences between the students were in large part responsible for differences in achievement scores in mathematics and Serbian language. Parental education, Roma minority status, developmental or family problems, gender, student motivation, parental involvement in student work and homework were some of the factors associated with student achievement. Serbian policy-makers are alerted to possible actions in order to improve mathematics and Serbian language achievement.

Keywords: school effectiveness; student background; Serbia; hierarchical linear modelling

Introduction

Considerable research in education has been driven by the key question: "What factors most influence student learning?" Most of the research that followed pioneering Carroll's (1963) and later Bloom's (1976) learning models has been undertaken within one of three different paradigms: (1) input–output studies, focused on finding relationships between various school inputs; (2) effective-schools studies, concentrated on the importance of school processes, particularly school organisation and administrative practices; and (3) studies on instructional effectiveness, centred on the links between teaching processes and school outputs (Scheerens 2000). While each research tradition has made strides in discovering factors that consistently influence student achievement, little research has given results on their relative importance and magnitude of their effects. This appears mainly due to four reasons.

First, these paradigms have been used mostly in isolation of each other, and therefore narrowly conceived models of schooling have been used to guide earlier research efforts, neglecting some potentially important teacher and school variables (Scheerens 2000). Second, most of the prior research relied on statistical procedures that were intended for only one unit of analysis, whereas the hierarchical nature of schools requires simultaneous management of several nested units of analysis (usually students, teachers, and schools; Scheerens 2000). Third, most prior research has been undertaken in countries where students are assigned to different teachers each year, making it difficult for researchers to discover the possible cumulative effects of teachers. Fourth, most

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studies have focused on either industrialised or developing countries. Since countries in economic transition have not been subject to these studies, it is not known whether teacher and school variables that associate with student achievement are different in such countries, which have different political, sociological and cultural backgrounds from those usually researched.

With the development of school effectiveness research (SER), first two problems have been addressed as researchers started to simultaneously examine a wide range of variables from three paradigms and use hierarchical linear modelling (Scheerens 2000). Often, however, SER studies are not guided by the conceptual model of school effectiveness in their choice of variables, and they fail to include all schooling levels in their hierarchical linear modeling (HLM) equations.

This paper and author's another paper aim to addresses the above-mentioned gaps in the field of school effectiveness by: (1) utilising a conceptual model of school effectiveness; (2) examining student, classroom and school levels in HLM models; (3) utilising data from students who have spent three years with the same teacher; and (4) exploring school effectiveness factors in Serbia, a transitioning country in a region that has so far very rarely been explored in SER.

This paper presents a detailed discussion of student-level findings for three reasons: (1) This is the first time that many important student-level variables have been simultaneously tested as predictors of student achievement at the primary school level in Serbia, and only the second time that it has been done at any level;[1] (2) the findings should strengthen and broaden school effectiveness knowledge base, considering that a small number of studies have tested conceptually integrated models using statistically sophisticated tools such as HLM; and (3) the results should inform education policy-making in Serbia, as the country lacks evidence-based research, operates on a tight budget and needs to improve the ability of its graduates to compete with those throughout Europe.

International research on student background factors

The now-famous 1966 Coleman report found that in the United States student background (mostly socio-economic) factors showed much stronger association with student achievement than any school-related factors (Coleman et al. 1966). In numerous small and several large-scale studies in industrialised countries it was shown that parental education and occupation, student's sex and age, family size and wealth, minority or immigrant status, single-parent family, cultural and educational possessions at home, parental involvement, participation in cultural activities, student's interest in reading, and time spent on homework associate with student achievement (Grissmer et al. 1994; Heyneman and Loxley 1982; OECD 2001).

Student background factors were shown to play an important role for student achievement in developing countries as well, but the magnitude of their effect appears to be smaller than in industrialised countries (Heyneman and Loxley 1982). Variables associated with achievement are parental education or occupation, family income, access to books, attitudes towards study, previous cognitive achievement, access to TV, IQ/ability, family size and student's age (Velez, Schiefelbein, and Valenzuela 1993).

In recent school effectiveness studies, student background factors have been integrated with classroom-level and school-level factors in terms of conceptual design, selection of variables and methodology. These studies, done mostly in industrialised countries (D'Agostino 2000; Driessen and Sleegers 2000; Hill and Rowe 1998; Mortimore et al. 1988; Muijs and Reynolds 2000; OECD 2001, 2004, 2007; Opdenakker

and Van Damme 2000; Opdenakker et al., 2002; Rowan, Correnti, and Miller 2002; Webster and Fisher 2000), confirmed the importance of the above-mentioned student background characteristics.

In industrialised countries, integrated studies usually showed that differences between student scores on achievement tests were more attributable to differences between individual students than to differences due to attending different classrooms and schools. In their meta-analysis of over a hundred school effectiveness studies Bosker and Witziers (as cited in Scheerens and Bosker 1997) estimated that around 19% of variance was between schools (including classrooms), but the range of the results was quite varied across the studies. PISA 2003 found that the average between-school variance within OECD countries was 28%, again with a varied distribution. However, this variance is not entirely due to the different classroom and school characteristics, since student background factors usually explain a portion of classroom and school variances, and are responsible for the compositional effect (OECD 2004; Opdenakker et al. 2002; Scheerens and Bosker 1997).

In developing countries, integrated studies have less frequently been undertaken, but they confirmed the importance or student background factors such as prior achievement, socio-economic status (SES), parental education, involvement and encouragement, student's age and sex, first language, family size, day care attendance, educational expectations, motivation, perceived mathematics activity and whether the student was a repeater (Dowd 2001; Lockheed and Longford 1989; Nyagura and Riddell 1993; Willms and Somers 2001).

These studies usually showed that between-student variance was larger than between-classroom and between-school variances, albeit to a lesser extent than in industrialised countries. In Zimbabwe, for example, 48% of the variance in student English test scores was between students, 44% was between schools, and 8% was between classrooms (Nyagura and Riddell 1993). In Thailand, 68% of the variance in mathematics scores (after controlling for pre-test) was between students, and 32% was between schools (Lockheed and Longford 1989). In 12 Latin American countries, between-student variance in both mathematics and language was around 50–70%, while between-school variance was around 30–50% (Willms and Somers 2001).

Serbian research on student background factors

Most SER in Serbia belongs to the student background category. However, in spite of the relative abundance of these studies, their conclusions are often tenuous due to methodological constraints.

A UNICEF study undertaken by a group of Serbian experts (UNICEF 2001) concluded that in Serbia, parental education showed a strong positive correlation with achievement, while family size showed a negative association. While both findings agree with the results of numerous other studies around the world, the authors did not control for any other factors that can potentially affect student outcomes, the sample was not representative, and significance levels were not reported.

In an impressive research effort to describe the educational and developmental attainment through primary school in Serbia, Havelka et al. (1990) found that in all eight grades, achievement as measured by grades and externally derived achievement tests was most strongly correlated with parental education level, parental occupation and results on an IQ test, followed by gender, motivation level, self-esteem, stance towards gender equality, low religiousness, unexcused absenteeism and several other

variables. All the correlation coefficients were smaller in lower grades and larger in higher grades. While the study used a nationally representative sample of students, collected rich data and for the first time painted a comprehensive picture of Serbian primary school education, none of the variables were tested simultaneously in a multiple regression equation to assess their relative importance.

Vucic, Baucal, and Petrovic (1994) treated the results on four IQ tests (used for assessment of kindergarterners' readiness for school) as the outcome variable. In many one-way ANOVA tests, they concluded that children's performance on tests was significantly related to parental education, and the family's financial and housing situation. However, several one-way ANOVA findings cannot properly determine the net contribution of several factors to student achievement. Additionally, the tested student population was also not representative of the Serbian population, so the results may not be generalisable.

Similar results were found by Smiljanic and Smiljanic (1998), when they looked for differences between students who have 5.00 GPA (grade point average; maximum) and those who have 4.00 GPA (with the exception of father's education level, which was not found to be a significant predictor of student achievement). In addition, the authors found that student characteristics as measured by results on Cattell's HSPQ questionnaire – emotional stability, responsibility, adaptiveness and independence – were significantly higher for better students. Again, since the authors tested each factor separately from others in many one-way ANOVA tests, they could not properly assess the relative importance of each factor for student achievement.

Gojkov (1992) found that the ability of students to study and learn on their own was significantly different between good students and bad students as measured by student grades. Again, an unrepresentative student sample and lack of control of any other school effectiveness variables preclude the readers from making any generalisable and reliable conclusions.

In addition to primary studies discussed above, the extent of variance in parental education – one of the major components of student socio-economic status – is likely extensive in Serbia, suggesting that this factor very likely impacts student achievement. In 1991, of the population 15 years of age and over 6.5% were illiterate, 1.9% were literate but without any formal education, 24.0% finished some grades of primary school, 24.5% finished primary school, 32.0% completed secondary school, 3.8% graduated from post-secondary institutions and 5.1% graduated from university (UNICEF 2001). Such distribution in parental educational status may indeed explain considerable amount of variance in student achievement.

Therefore, both primary studies and the examination of variance in student background factors suggest that student background plays an important role in student achievement in Serbia, despite its socialist past. Due to methodological shortcomings, the extent of this effect has not been identified and needs to be explored. The research undertaken in Serbia could benefit from studies that simultaneously examine relationships between student achievement and a wide variety of variables, and employ sophisticated methodological tools.

Methods

Tests and questionnaires

In May 2004 the Institute for Education Quality and Evaluation (IEQE) carried out a large-scale study of Serbian primary education. National tests in Serbian language and

Table 1. Descriptive statistics for dependent variables.

	N	Minimum	Maximum	Mean	Standard deviation
Mathematics IRT score	4857	32	937	501.1	95.753
Serbian language IRT score	4857	−33	1017	498.9	103.12

mathematics were developed to test new standards for elementary schooling that gave less emphasis to rote memorisation and more to the application of knowledge, than was previously customary in Serbia. Each national test was developed by a team of 25 experienced teachers from schools in Serbia, who were trained, advised and guided by the experts from the IEQE. Numerous test questions were piloted on about 3000 students in May 2003 and refined based on the input obtained from students, teachers and World Bank consultants. The tests contained multiple-choice and open-ended problems/questions, which were graded by primary school teachers who did not know the students and who were trained by the IEQE. Table 1 shows descriptive statistics for the IRT scores on the achievement tests in Serbian language and mathematics. The means for both tests were set to 500 by the IEQE, but the table shows means for the slightly smaller student sample used in this study.

Information about students, teachers and principals were collected from school records and three types of questionnaires developed by this author in collaboration with the IEQE. The questionnaires were based on the conceptual model of school effectiveness, which was, in turn, created by merging four conceptual models proposed previously by SER researchers (Creemers 1994; Heneveld and Craig 1996; Scheerens 1990; Wang, Haertel, and Walberg 1993). The conceptual model is shown in Table 2.

Each of the constructs in Table 2 is represented by a set of variables. Detailed description of the student-level variables is given in Table 3.

For each construct and its associated variables, items were largely developed by modifying items used in school effectiveness empirical studies, from knowledge of the organisation and functioning of Serbian schools, and through consultations with experts at the IEQE and the George Washington University. Some of the items that measure some student-level variables were collected from school records and/or teachers and principals (e.g. educational attainment of parents) in order to reduce measurement error and improve data reliability. All questions on the questionnaires were closed-ended, and most of the questions were four-point Likert-type questions. The format and wording of scale responses were mostly taken from similar school effectiveness studies, such as PISA 2000. The questionnaires were field-tested on about 20 third graders, five teachers and five principals from Serbian public elementary schools.

The test results, questionnaire responses, as well as the collected personal data, was keyed into the SPSS format and verified by the IEQE in the summer and fall of 2004. Additional data verification and replacement of missing values was carried out by the author. Typically the non-response for each item was 3–5%. Missing values were obtained either from other highly correlated items or by imputation with the mean or median.

Many of the student-level variables and most of the classroom- and school-level variables were computed from the items that were included in Principal Components Analysis (PCA) with orthogonal (varimax) rotation and Principal Axis Factoring

Table 2. Conceptually integrated model of school effectiveness.

Student level	1. Intelligence 2. Prior achievement (including history of educational placement) 3. SES (parental educational attainment, parental occupational status, family wealth, family structure) 4. Student characteristics (student demographics, such as age and gender, social and behavioural, motivational and affective, cognitive, metacognitive, psychomotor characteristics) 5. Parental support 6. Home environment (cultural possessions at home, communication on social issues and aspects of culture) 7. Opportunity to learn (including use of out-of-school time) 8. Time on task
Classroom level	1. Teacher characteristics (SES, experience, salary, education, sex, teacher development, advance preparation of teachers, demographics, social and behavioural, motivational and affective) 2. Classroom instruction (clarity of presentation, teaching of skills until mastery is achieved, emphasis on the acquisition of basic skills, teaching of learning strategies, direct, structured teaching, grouping procedures, cooperative learning, tutoring, variety in teaching strategies) 3. Opportunity to learn (curriculum and textbooks, clear correspondence between covered material and tests) 4. Time on task 5. Student assessment and feedback (in-class and on homework) 6. Student and teacher social and academic interactions (reinforcement, high expectations of student progress, flexibility, enthusiasm) 7. Classroom climate (orderly atmosphere)
School level	1. School demographics (school size, school category, urban/rural) 2. School infrastructure and services (facilities, textbooks and other materials, administrative expenses, per student expenditure) 3. School culture (ethos conducive to teaching and learning, degree of an achievement-oriented policy, high expectations of students, frequent assessment of student progress, orderly atmosphere, accessibility, parental involvement policy) 4. School climate (educational leadership, teacher attitudes, rewards and incentives, decision making, cooperation)
Contextual level	1. Higher administrative levels (support, policies, flexibility and autonomy, design of curriculum, time-in-school, development of educational consumerism) 2. Community support 3. Cultural conditions 4. Political conditions 5. Economic conditions

Table 3. Descriptive statistics of student-level variables (unweighted).

Variable	Description
Prior achievement	
Repetition of or promotion to a grade	Dichotomous, one teacher-reported item, 1 = student repeated or was promoted to a grade in spite of the failing grade, 0 = other. Such students represent 1% of the sample.
Preparedness for the first grade	Average of five student-reported four-pt items in factor analysis (ability to do the following activities without anyone's help at the beginning of the first grade: read all the letters, read children's books, write all the letters, write first and last name, and add and subtract numbers up to 10). Reliability of the scale is 0.82.
Mathematics grade at the end of Grade 1	One teacher-reported item.
Serbian language grade at the end of Grade 1	One teacher-reported item.
SES	
Family composition	Dichotomous, teacher- and student-reported items, 1 = student lives with 0 or 1 parents/guardians, 0 = student lives with two-parents/guardians. Such students represent 10% of the sample.
Number of children in family	One teacher-reported item.
SES estimate	One teacher-reported item.
Parental education	Average parental education, one teacher-reported item.
Student characteristics	
Student's gender	Dichotomous, one teacher-reported item, 1 = female, 0 = male. 48% of students in the sample are female.
Developmental problems	Dichotomous, one teacher-reported item, 1 = student has developmental problems, 0 = other. 16% of the students in the sample have developmental problems.
Family problems	Dichotomous, one teacher-reported item, 1 = student has family problems, 0 = other. 6% of the students in the sample have family problems.
Walks to school more than 3 km	Dichotomous, one teacher reported item, 1 = student walks to school more than 3 km, 0 = student walks to school up to 3 km. 6% of the students in the sample walk to school more than 3 km.
Roma minority	Dichotomous, one teacher-reported item, 1 = student is a Roma minority, 0 = other. 3% of the students in the sample are Roma.

Table 3. (*Continued*).

Variable	Description
Refugee or IDP	Dichotomous, one teacher-reported item, 1 = student is a refugee or IDP, 0 = other. 5% of the students in the sample are refugees or IDPs.
Joined the classroom afterwards	Dichotomous, one student-reported item, 1 = student joined the classroom after the beginning of the first grade, 0 = student was in the classroom since the beginning of first grade. Such students represent 11% of the sample.
Student's age	One teacher-reported item.
Day care/pre-school attendance	One student-reported item.
Motivation for and interest in the subject	Average of four student-reported four-pt items in factor analysis (importance to know the subject very well, easiness of learning the subject or doing homework in the subject without anyone's help, student's perception of the subject as interesting vs. boring, and student's belief in being able to know the subject very well). Separate variables for mathematics and Serbian language. Reliability of the scale for mathematics is 0.64. Reliability of the scale for Serbian language is 0.70.
Parental support	
Parental involvement	Average of seven student-reported four-pt items in factor analysis (parents check whether the student finished homework, parents explain unclear study or homework material to student, parents praise or reward student for a good grade, parents ask student what went on in school, parents and student talk about student's day, parents and students talk about books, movies, sport and similar things, and parents and students get along well). Reliability of the scale is 0.84.
Lack of parental strictness	Average of two student-reported, reverse-coded four-pt items in factor analysis (parents scold or punish student when she or he gets a bad grade, and parents are strict with the student). Reliability of the scale is 0.55.
Opportunity to learn	
Out-of-school activities	Student-reported hours spent on out-of-school activities (playing with friends, watching TV, and playing video-games, added).
Reading	Average of two student-reported items in factor analysis (reading children's magazines and reading children's books). Reliability of the scale is 0.64.
Time on task	
Student's absenteeism	Teacher-reported weeks of student's absenteeism, standardised.

Table 3. (*Continued*).

Variable	Description
Homework	Student-reported hours (in 30 min increments) spent on homework in the subject. Separate variables for mathematics and Serbian language.
Remedial work in the subject	Average of three student-reported four-pt items in factor analysis (studying or doing homework in the subject with a family member, having private tutoring in the subject, and having remedial subject lessons in school). Separate variables for mathematics and Serbian language. Reliability of the scale for mathematics is 0.55. Reliability of the scale for Serbian language is 0.58.
Control variables	
First tested in Serbian language	Dichotomous, 1 = student first tested in Serbian language, 0 = other. 49% of the students in the sample were first tested in Serbian language then mathematics.

(PAF) with two oblique rotation options (direct oblimin and promax). Only a few items were eliminated during the course of PCA solution building. Components corresponded well to the theory-implied constructs. Cross-validation of the obtained solutions in random halves of the sample was possible for the student dataset, but not for the teacher and principal datasets, as they were too small ($N = 253$ and $N = 119$).

Almost all variables that were computed from categorical Likert-type items were treated as continuous variables. At the student level, many such predictors were negatively skewed; this likely undercontrols for student background and therefore provides lower-bound estimates of the true relationships at the student level. Several variables were eliminated from the analyses because they showed very little variation. Variables were grand-mean centred at the student level in a three-level HLM model.

Two constructs from the conceptual model could not be adequately measured in this study – Intelligence and Home environment. Even though IQ tests are administered to most Serbian students at the beginning of the first grade by school psychologist, those data were not accessible to this researcher. Home environment construct is not separately represented in this study as four items intended to measure it comprised a common variable with Parental support variable, and additional two overlapped with items capturing a reading variable from the Opportunity to learn construct.

Sample

The sample of students in this study was a stratified, multistage random sample. Two schools were randomly selected from the set of rural schools and two schools were randomly drawn from the set of urban schools, for each of the 25 administrative counties (strata) in Serbia. On occasion, more than four schools were chosen from one stratum in order to collect sufficient data from multi-grade classrooms, which serve the most remote areas in the country. Additionally, more schools were drawn from two counties where the two largest cities in Serbia are located (10 schools in the Belgrade county and six schools in the Novi Sad county). A total sample of 119 public elementary schools was selected.

The number of students in Grades 1–4 (lower elementary) in the sampled schools ranged from 34 to 1086, with an average of 339 (only four schools had more than 700). The total number of third-grade classrooms in school (including outpost and multi-grade classrooms that are located some distance from school's main facility) ranged from 1 to 19, with an average of 4.70 per school. The number of third-grade classrooms located *within* the school (81% of all classrooms) ranged from 1 to 11, with an average of 3.08 classrooms per school.

In each school, commonly two third-grade classrooms were randomly chosen to participate in the study from all regular and outpost classrooms administered by a school. However, some schools had only one third-grade classroom (and therefore a classroom from a similar school from the same county was chosen). A total of 26 schools in the sample were represented by only one classroom. A total sample of 253 classrooms was selected. The number of students per classroom ranged from 4 to 34, with an average of 21.46 students.

All students present in the classroom during the day of data collection took achievement tests in mathematics and Serbian language and answered the Student questionnaire. There were 5216 students in the drawn sample. Teachers of the selected classrooms, as well as principals of selected schools, also provided responses on the same day to the Teacher questionnaire and Principal questionnaire, respectively.

Given that sampling was not proportional at each of the three levels, the results of the study might not be representative of the student, classroom and school populations in Serbia. Since four schools on average were chosen from each of the 25 counties, schools, as well as classroom and students, from counties with smaller numbers of schools were over-represented in the sample. This was partially countered by selecting a larger number of schools from the two counties with the largest number of schools. Likewise, since two classrooms were chosen on average from each school, classrooms and students from schools with a smaller number of classrooms were over-represented in the sample. This sampling bias was partly mitigated at the student level because all students in the classroom were tested and therefore students from smaller classrooms and students from larger classrooms were proportionately represented. Design-related controls, such are class size, school size, urban/rural location and classroom type (regular urban, regular rural, outpost or multi-grade) in the HLM analyses were used to somewhat control for absence of appropriate weights.

Participation rates at all three levels were excellent. Data were collected from all 119 schools and 253 classrooms that were drawn into the sample, making for 100% response rates at those levels. Of the 5216 student units drawn in the student sample, 303 students were absent from school on the day of testing, and 56 students were eliminated from the analysis because of the excessive missing data, resulting in a 93% response rate at the student level.

Findings

Random effects

Serbian students, classrooms and schools differ significantly in their achievement both in mathematics and in Serbian language. Fully unconditional model, Model 0, shows that 86.7% of variance in mathematics scores lies between the students, 5.4% lies between the classrooms and 7.9% lies between the schools. In Serbian language, 83.9% of variances in test scores is due to the students, 6.0% is due to the classrooms and 10.0% is due to the schools (Table 4).

In Model 1A, 24 grand-mean centred predictors were simultaneously included at the student level in order to showcase the impact of student background variables on student achievement that has accumulated throughout student's life until the time of achievement testing for this study. These variables explained 31.6% of student-level variance in mathematics (27.4% of total variance) and 35.1% of student-level variance in Serbian language (29.5% of total variance). In addition, these variables explained

Table 4. Unexplained variances in fully unconditional model and two student-level models.

	Mathematics			Serbian language		
Unexplained variance	Model 0	Model 1A	Model 1B	Model 0	Model 1A	Model 1B
Student	0.871	0.596	0.456	0.844	0.547	0.432
(s.e.)	(0.018)	(0.012)	(0.010)	(0.018)	(0.011)	(0.009)
Classroom	0.054	0.036	0.052	0.061	0.036	0.053
(s.e.)	(0.013)	(0.008)	(0.010)	(0.014)	(0.008)	(0.010)
School	0.080	0.019	0.040	0.101	0.037	0.057
(s.e.)	(0.018)	(0.008)	(0.011)	(0.022)	(0.010)	(0.014)

33.8% of classroom-level variance in mathematics (1.8% of total variance) and 40.1% of classroom-level variance in Serbian language (2.4% of total variance), as well as 76.1% of school-level variance in mathematics (6.0% of total variance) and 63.6% of school-level variance in Serbian language (6.4% of total variance).

As a preparation for introduction of classroom- and school-level variables into the study, Model 1B was constructed by adding grades from the end of the first grade to other student-level predictors from Model 1A. These grades are not an ideal measure to capture and control for pre-schooling influences because they are usually a crude measure of prior achievement scores and IQ results that are routinely used to remove pre-schooling differences among students. Moreover, they are shaped to a degree by teacher's interaction with the student and other school influences that happened during the first grade, and they therefore likely account for some teacher and school effects that accrued during the first grade. Nonetheless, they are the best proxy available, as they allow for isolation of classroom and school influences that have accumulated over the course of student's second and third grades.

The inclusion of grades as controls greatly increased the amount of explained student-level variance in both mathematics and Serbian language: student-level predictors in Model 1B explained 47.6% of student-level variance in mathematics (41.3% of total variance) and 48.8% of student-level variance in Serbian language (40.9% of total variance). These 25 predictors explained 4.5% of classroom-level variance in mathematics (0.2% of total variance) and 12.4% of classroom-level variance in Serbian language (0.8% of total variance), as well as 49.8% of school-level variance in mathematics (4.0% of total variance) and 43.2% of school-level variance in Serbian language (4.3% of total variance). In other words, in comparison to Model 1A, in Model 1B student body composition was better adjusted for and therefore it played a smaller part in explaining differences among classrooms and schools in both mathematics and Serbian language. Therefore, Model 1B allows for more unexplained variance to remain at the classroom and school levels, which can then be explained by classroom-level and school-level constructs.

Fixed effects

Table 5 shows the intercept and gamma coefficients for student-level variables from Model 1A and Model 1B for each subject area. Considering that all student-level variables were grand-mean centred in the HLM analyses, baseline achievement is the average achievement of students in a classroom that has population average student characteristics (classroom has 48% of female students, all students have population average amount of parental support, etc.).

The findings presented in Table 5 are for the most part expected and in line with theory. A large effect will be considered to be above 50% of standard deviation, medium effect 30–50%, small effect 10–30% and very small effect below 10% of standard deviation.

Intelligence/Prior achievement

Variable that measured student preparedness was small, positive and significant in Serbian language and insignificant in mathematics. This probably happened since more opportunities to acquire Serbian language knowledge exist prior to school than there are opportunities to acquire mathematical knowledge.

Table 5. Standardised student-level gamma coefficients, Models 1A and 1B.

	Mathematics		Serbian language	
	Model 1A	Model 1B	Model 1A	Model 1B
Intercept (s.e.)	–0.008 (0.021)	–0.014 (0.026)	–0.003 (0.024)	–0.007 (0.029)
Variable	Gamma coefficient (s.e.)			
Prior achievement				
Grade repetition or promotion to the next grade in spite of failure	–0.790** (0.171)	–0.295* (0.157)	–0.741** (0.171)	–0.243 (0.090)
Preparedness at the beginning of first grade	0.016 (0.012)	0.005 (0.010)	0.049** (0.013)	0.028** (0.011)
Final grade in subject at the end of the first grade		0.478** (0.014)		0.439** (0.013)
SES				
Does not live in a two parent/guardian family	0.014 (0.037)	0.055* (0.032)	0.051 (0.034)	0.100** (0.033)
Number of children in family	–0.033** (0.013)	0.001 (0.010)	–0.041** (0.014)	0.000 (0.011)
Teacher's estimate of student SES	0.041** (0.014)	–0.009 (0.013)	0.054** (0.015)	0.009 (0.012)
Parental education	0.245** (0.016)	0.104** (0.015)	0.2401** (0.016)	0.119** (0.013)
Student characteristics				
Female	–0.058** (0.021)	–0.082** (0.019)	0.176** (0.021)	0.099** (0.021)
Has developmental problems	–0.180** (0.038)	–0.095** (0.032)	–0.181** (0.034)	–0.078** (0.028)
Has family problems	–0.207** (0.058)	–0.108* (0.058)	–0.171** (0.056)	–0.062 (0.044)

Table 5. (*Continued*).

	Mathematics		Serbian language	
	Model 1A	Model 1B	Model 1A	Model 1B
Intercept (s.e.)	–0.008 (0.021)	–0.014 (0.026)	–0.003 (0.024)	–0.007 (0.029)
Variable	Gamma coefficient (s.e.)			
Walks to school more than 3 km	0.012 (0.047)	0.043 (0.052)	–0.060 (0.053)	–0.044 (0.047)
Roma minority	–0.315** (0.087)	–0.164** (0.078)	–0.231* (0.122)	–0.049 (0.064)
Refugee or internally displaced person	–0.049 (0.065)	–0.016 (0.051)	–0.049 (0.063)	–0.028 (0.049)
Joined the classroom after the beginning of first grade	–0.122** (0.033)	–0.070** (0.031)	–0.125** (0.041)	–0.064* (0.032)
Age	0.039** (0.012)	0.024** (0.012)	0.029** (0.011)	0.018 (0.010)
Time spent in day care/pre-school	–0.013 (0.014)	–0.014 (0.012)	–0.010 (0.013)	–0.014 (0.011)
Student motivation for subject	0.136** (0.013)	0.081** (0.011)	0.079** (0.013)	0.044** (0.011)
Parental support				
Parental interest and involvement in student's school work and life	0.138** (0.012)	0.077** (0.010)	0.150** (0.012)	0.093** (0.010)
Lack of parental strictness	0.057** (0.012)	0.039** (0.011)	0.067** (0.012)	0.051** (0.010)
Opportunity to learn				
Time spent on out-of-school recreational activities	–0.000 (0.012)	–0.006 (0.011)	–0.026** (0.011)	–0.036** (0.010)

Table 5. (*Continued*).

	Mathematics		Serbian language	
	Model 1A	Model 1B	Model 1A	Model 1B
Intercept (s.e.)	–0.008 (0.021)	–0.014 (0.026)	–0.003 (0.024)	–0.007 (0.029)
Variable	Gamma coefficient (s.e.)			
Reading done outside of classroom	0.050** (0.014)	0.031** (0.011)	0.057** (0.014)	0.032** (0.011)
Time on task				
Time absent from school	–0.016 (0.011)	–0.002 (0.010)	–0.013 (0.013)	–0.004 (0.011)
Time spent doing homework in subject	–0.102** (0.013)	–0.072** (0.011)	–0.102** (0.012)	–0.071** (0.010)
Remedial work in subject	–0.204** (0.013)	–0.124** (0.011)	–0.220** (0.012)	–0.147** (0.011)
Control variables				
Took achievement test first in mathematics, then in Serbian language	0.032 (0.035)	0.016 (0.036)	–0.000 (0.033)	–0.004 (0.033)

*p-value < 0.10; **p-value < 0.05.

The largest impact of all student-level variables in Model 1A in both subjects was exerted by a variable indicating whether a student repeated or was promoted to the next grade in spite of the failing grade; this characteristic obviously describes a poor student.

SES

Parental education variable exhibited expected positive sign and magnitude – the better educated parents the higher achievement score of a student. For example, student with parents who had, on average, completed secondary school (approximately variable's mean) scored around half a standard deviation above a student with parents who had, on average, completed only primary school (approximately two standard deviations lower than variable's mean). On the other hand, student with parents who had, on average, completed secondary school scored around half a standard deviation below a student with parents who, on average, completed university (approximately two standard deviations above than variable's mean). In other words, highest level of parental education (university, completed by parents of 8% of student sample) associates with a full standard deviation advantage in test scores over second-to-last parental level of education (primary school, completed by parents of 18% of student sample), net of other factors.

Family wealth variable was captured by teacher's estimate of student's socioeconomic status.[2] Slight positive effect of family wealth variable implies that being in a wealthier family slightly associates with higher achievement. However, in comparison to parental education, this variable exhibited a rather weak effect, at least partly as a consequence of greater variation in parental education than in family wealth (legacy of country's communist past).

Unfortunately, information on parental occupational status – another measure of student SES – was not available for around 30% of students, and therefore was not used as a proxy of SES.

Family structure bore no significance on achievement: students who live in two parent/guardian families exhibited baseline achievement, while having more brothers and sisters was associated with a small loss in achievement.

Student characteristics

Of student demographic characteristics, a Roma minority status exerts the largest effect on student achievement in both mathematics and Serbian language. This finding is expected, as Roma minority is the most discriminated against and disadvantaged minority in Serbia. However, this variable has considerably (by a third) smaller impact on Serbian language score than on mathematics score. This likely happens because third-grade knowledge of Serbian language is more easily acquired in informal situations outside of school than is third-grade mathematics knowledge. In addition, most Roma in Serbia either speak Serbian at home or are in contact with Serbian since birth and therefore have little second language problems.

Being a refugee or an internally displaced person has no net impact on student achievement. This finding may be due to the fact that many ten-year-old refugees or IDPs in Serbia were either not born yet or were very young during their displacement from Croatia, Bosnia and Herzegovina or Kosovo, so they may experience fewer refugee-related problems than their older counterparts.

Being female has a very small negative effect on mathematics achievement (5.8% lower than baseline) and a small positive effect on Serbian language achievement (17.6% of standard deviation higher than baseline). Considering that the baseline achievement is comprised from approximately same proportions of female (48%) and male students (52%), the actual difference between males and females is twice that effect. This may be due to traditional expectations of gender dominance in "hard sciences" and "language arts" self-fulfilled by girls and boys in Serbia and/or due to possibly true gender differences in mathematical and linguistic predispositions.

Older students have a very small advantage in achievement.

Having developmental problems or experiencing family problems is expectedly associated with lower student achievement in both subjects, as those students may be discriminated against, neglected by parents, be less secure, have less emotional support and have studying at home more frequently disrupted than other students. It should be noted though that these variables were assessed by teachers, so they may be somewhat unreliable.

Joining the classroom after the beginning of the first grade has a small negative effect on achievement. This may happen if worse achievers are the ones who are moved by parents to another school or classroom in order to avoid getting poor grades or repeating a class. Alternatively, this finding may imply that disrupting student's security in and familiarity with academic setting in early years of school has negative consequences on student's achievement.

Attending day care/kindergarten for any length of time is neither an advantage nor a disadvantage for children with respect to their future academic success, even though it may affect students in social or emotional ways that have not been examined in this study. However, this variable was student-reported, so it is possible that it is a rather unreliable measure of day care attendance.

Student's motivation for and interest in the subject show positive association with student achievement, more so for mathematics than for Serbian language. This implies that students do not necessarily have to have high motivation and deep interest in a native language to perform well, as language abilities come more naturally to them than mathematical abilities do, and as they use Serbian on a daily basis. However, it is unclear whether students' motivation leads them to higher achievement, or whether higher achievement generates high motivation.

Parental support

Variable that captures parental expectations and demand for achievement was eliminated from analyses because of small variation – over 75% of students reported that their parents expect and demand high achievement in mathematics and Serbian language.

Children with parents who are less strict and who rarely or never scold or punish them for bad grades scored higher than the baseline. This may be due to the negative effect of negative parental behaviour on achievement or due to the possibility that such parental behaviour is initiated by student's poor grades.

On the other hand, students with parents who frequently talk to them, ask about school day, help out with problems, check whether a student finished homework, praise children for good grades and in general get along with their children have an advantage over the baseline. While some of these parental behaviours can also be triggered and/or reinforced by student's success in school, it is also quite likely that parental diligence and involvement do contribute to student achievement (since some of

above-mentioned parental behaviours – for example, helping out with problems – should not be reinforced by good grades).

Opportunity to learn

Reading books or children's magazines shows a very small positive relationship with achievement in both mathematics and Serbian language. It should be noted that other out-of-school learning opportunities for students (going to museums, watching plays, etc.) were not assessed in this study due to constrained questionnaire length.

The amount of time that student spends playing with friends, watching TV or playing video games has no impact on student achievement in mathematics and a very small negative association with Serbian language achievement. Considering that students in Serbia finish school around 1 pm in third grade, they likely have plenty of time to both do the homework and engage in free time activities. It would be worthwhile examining this relationship in higher grades, when homework begins taking up considerable time.

Time on task

Variable capturing the amount of time spent on homework in the subject shows that increasing time spent on homework associates with poorer student achievement. In other words, students spending more time on homework likely do not have academic advantages, but are struggling more to finish the homework. If there are students in the sample who spend more time on the homework because their teacher assigned more of it, and not because they are struggling with it, the potential effect of more homework does not show either because there are few of those students in comparison to struggling students, because the effect of more homework is insignificant or small, or, perhaps, because of the combination of the two. A variable that directly measures the amount of homework assigned by the teacher was not used at the classroom level.

It should be noted though that this variable was altered in that a small percentage of students who spend no time on homework (1–2% of the sample) was placed behind the students who spend more than two hours on homework because they showed poorest achievement when time-on-homework was tested as a predictor of student achievement as a series of dummy variables. This finding supports theory that doing homework as opposed to not doing it is strongly associated with higher student achievement, even if a student struggles and spends two or more hours on it.

In comparison to students who almost never need remediation, those who spend time on remedial learning at home or in school score considerably lower on the achievement test in both mathematics and Serbian language.

Finally, student absenteeism does not play a part, because third graders likely do not cut classes or are sick for extended periods of time.

In Model 1B, mathematics and Serbian language grades show by far the largest effect on student achievement. For example, student with the highest possible grade (attained by around 50% of students) scores around half a standard deviation higher than the student with only one grade lower (attained by around 25% of students). These very large effects of grades, as well as diminished effects of other variables, were expected, as grades are correlated to a degree with many measured student-level variables, likely encompassing an array of observed and unobserved student background characteristics that are also largely responsible for the student's score on achievement tests.

Importantly however, many student background variables retain their significance and often non-negligible effects in Model 1B, i.e., after the effect of pre-schooling influences is removed through the grades from the end of the first grade. In other words, it appears that the student background factors in Serbia not only work up to the entry to school, but that they also continue to operate during the schooling. On the one hand, it is likely that better controls of student background would have diminished its impact on student learning in school. On the other hand, though, prior research in Serbia shows that the correlations between student grades/achievement tests and parental education level, parental occupation, IQ scores, motivation level, self-esteem and several other variables increase as students progress through school (Havelka et al. 1990). This implies that the schools in Serbia cannot eliminate or even maintain the level of the initial student background effect on student learning (regardless of its absolute value).

Implications for education policy

Student-level variables are largely considered non-manipulable by education policy. However, 85% of variance in achievement in Serbia lies between students, and about half of this variance is explained by variables utilised in this paper. In addition, it appears that in Serbia, student background plays a role in both initial student achievement and subsequent student learning. This should warrant the government's interest in the student-level factors presented in this paper. Three principles for improvement based on the effects of student variables are presented below:

(1) Poor performance of disadvantaged groups – Roma students, students with poorly educated parents, students experiencing family problems and students with developmental problems – needs to improve if Serbia aims for equity as well as high achievement. Diminishing educational gaps in early childhood is highly recommended in order to counter widening socio-economic gaps that will likely follow Serbia's further transition towards capitalism. It may be sensible to identify vulnerable populations before school (through the health care system, during childhood visits and hospitalisations) and offer them learning opportunities in intensive, quality pre-school programmes with likely long-term individual *and* societal effects (Barnett 1985; Schweinhart et al. 2004). Alternatively, strategies that would be effective for both disadvantaged and mainstream children should be identified in Serbian and international research and applied in regular pre-schools.
(2) Given the effect of parental education on student achievement, attaining high levels of education in current population of students would provide for better educated future generations. Currently, however, a student's choice of a particular secondary school at age 15 (which is determined largely by her or his GPA in the primary school) almost automatically closes that student's door to enrolling at many three-year colleges or four-year faculties at the university level. Making courses more inter-connected and transferable among different types of secondary schools, and aligning secondary school curricula with curricula at institutions of tertiary education would allow more students to find their true interests and attain higher levels of education instead of being locked up in a profession determined by their primary school grades.
(3) Finally, additional efforts could be undertaken by the government in order to alter other student-level variables that associate with student achievement in

this paper and in prior literature on student background (higher parental involvement and interest in student school work, higher motivation for and interest in subject matter, lower parental strictness, doing homework and reading). Public campaign and greater, thought-out and targeted involvement of parents in students' school work should be planned.

Overall, then, the findings in this paper should build up school effectiveness knowledge base and strengthen evidence-based policy-making in Serbia. It is also hoped that this study will inspire researchers in Eastern Europe to undertake more rigorous study designs, both conceptually and methodologically.

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Notes

1. This study was undertaken somewhat concurrently with PISA 2003, which for the first time analysed achievement of 15-year-old Serbian students in its report. The analyses presented here – which focused on primary school students – were already under way when PISA 2003 was published.
2. This variable, even though it asked a teacher about student's socio-economic status (that encompasses more than just family wealth) referred to family wealth in this case, as offered responses were: "very rich", "rich", "average", "poor" and "very poor".

Notes on contributor

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