Social, Economical, and Educational Factors in Relation to Mathematics Achievement

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Abstract

In the article, impacts of some social, economical, and educational factors for the students' mathematics achievements in Lithuania are analyzed. For that purpose, we use data from TIMSS 2003 survey.

The home–related factors include parents' education and possession of various educational resources at home. In most cases, relationship between those factors and students' mathematics achievements is established. The factors related to the characteristics of teachers (including gender, age, type of studies, and professional development) are also analyzed, and show relationship with the achievements, although not always expected one. A very strong relationship between the mathematics achievements and the type of school locality is found.

Keywords: *Mathematics achievements, socio-educational factors.*

Introduction

For years, the question of the impact of various social, economical, and educational factors on students' educational achievements has been of great interest to the researchers in education, economics, and other social sciences. To quote but few, Israel et al (2001) conclude that both parents' socioeconomic status and social capital available in the family promote child's educational achievement. Further to that, they note that community social capital also helps children excel in school, although it makes a smaller contribution to academic performance. Blau (1999) analyzes the effect of parental income on children's cognitive, social, and emotional development and concludes that the effect of current income is small; the effect of "permanent" income is substantially larger, but relatively small when compared to the family background characteristics, such as parental education and household structure. Jensen and Seltzer (2000) show that individual, family, and neighbourhood factors all influence further education decisions of young Australian students. Lee and Croninger (1994) model the influence of both home and school environment on the literacy development of children. Although home factors seem to have a stronger impact, authors focus on analyzing school impact and argue that schools have major opportunities and responsibilities for equalizing the development of their students, although it is easy and common for schools to ascribe the learning disadvantages of their less affluent students to deficient home environments. Thirunarayanan (2004) compares students' achievements in different content areas by school location in the United States and concludes

that students in central-city schools in the United States perform statistically "significantly worse" in many subject areas than students in suburban schools.

Having a number of indications about the relationship between the students' educational achievements and some socio-economic factors, we want to investigate if similar relationships would work out in the case of Lithuanian students' achievements in mathematics. For that purpose, we use the database of TIMSS 2003, the newest international survey on mathematics and science achievements. Data from the Grade 8 students', their mathematics teachers' and school headmasters' levels is used in the analysis. We apply weights that take into account the complex sample design. The students' mathematics achievements referred to in the article correspond to the scale made using the IRT (Item Response Theory) modelling. Levels of achievements (low, minimal, intermediate, high, and advanced), corresponding to international benchmarks, are also used for analysis with crosstabs and χ^2 test. In the article we do not attempt to offer a deep analysis of the possible reasons behind the impact of various factors found, but simply present an overview of some interesting relationships seen from the data.

Family background

Social and educational background of the family can be measured by a number of variables. In this article, we analyze the ones that are found to be most useful in defining the socio-educational atmosphere of home, namely, parents' level of education, and number of books at home.

Parents' education was aggregated into three categories: *lower* than secondary (none, primary, basic or unfinished secondary), *secondary* and *higher* than secondary (college, university and similar). χ^2 test shows a statistically significant relationship between the level of parents education and the levels of mathematics achievement ($\chi^2 = 80.302$, $p<0.01$; for illustration see 1 table).

1 table. Relationship between the Mother's level of education and student's level of mathematical achievement

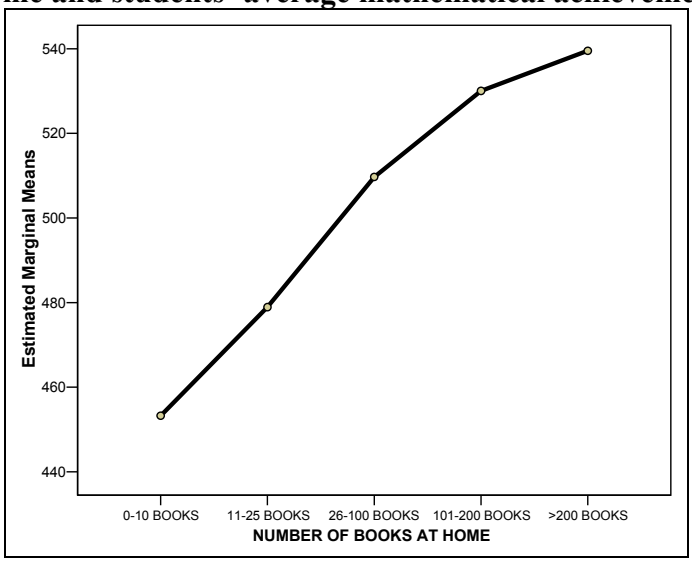
Mother's level of education	Levels of mathematics achievements (% of students)					Total
	Low	Minimal	Intermed.	High	Advanced	
Lower	20,1	40,9	23,9	15,1	0,0	100
Secondary	14,0	33,9	32,2	16,1	3,8	100
Higher	8,4	25,0	38,6	22,9	5,1	100

ANOVA shows the same trend: the higher the level of parents' education, the better the average achievements of students. Differences between categories

are about 23 points and are statistically significant (F=44.080, p<0.01; Bonferroni criteria used for adjustment for multiple comparisons, p<0.01).

Both χ^2 test (χ^2=508.476, p<0.01) and ANOVA (F=156.679, p<0.01) also show statistically significant differences in achievements related to the number of books at home. 1 diagram illustrates the rise of the average achievements related to the higher number of books at home.

1 diagram. Relationship between the number of books at home and students' average mathematical achievement

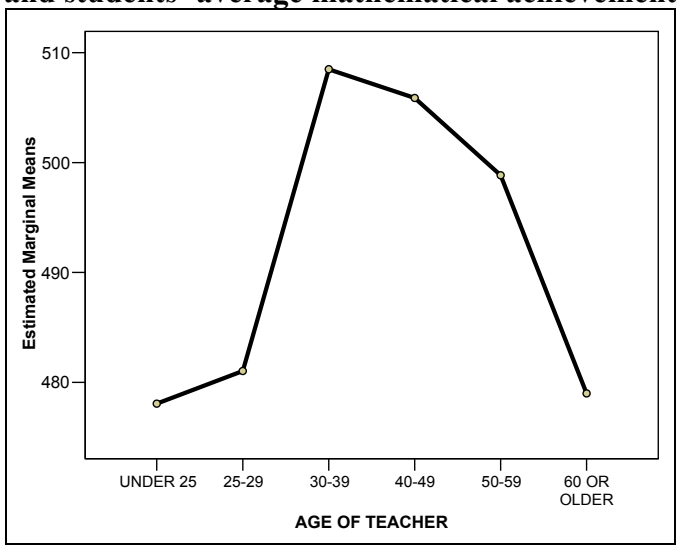


Teachers' characteristics

We considered several of the teachers' characteristics investigating if students' achievements in mathematics depend on their mathematics teachers' gender, age, type of completed studies, and participation in the professional development courses.

ANOVA shows statistically significantly different results based on the teachers' age (F=14.527, p<0.01): the best results were obtained by the students whose teachers were 30-39 and 40-49 years old, a little bit lower results – by the students whose teachers were 50-59 years old. Students of both very young (less than 30) and relatively older (more than 60 years old) teachers on average performed worse than their peers with the teachers from the middle categories ages (see 2 diagram).

2 diagram. Relationship between the age of a teacher and students' average mathematical achievement



In the analysis of the impact of teacher's gender on the mathematical achievements of the students, we find that on the average, students with the female teachers perform better than their peers with the male teachers. Difference is statistically significant ($F=6.316$, $p<0.05$), although not very high (just about 12 scale points). However, when we look deeper into the problem and analyze data for cities/towns and country-side students separately, we see that the difference mainly comes from the male teachers in the country-side schools (difference is about 30 scale points), and the students of female and male teachers in cities/towns perform on the average similarly.

The area of main studies of the teacher did not show any statistically significant impact on the students' mathematical achievements except in the case of teachers whose area of studies was science. In that case average achievements (especially in the country-side) were lower than other students' ($F=26.383$, $p<0.01$).

An interesting relationship is established analyzing the impact on students' mathematical achievement by their teachers' participation in the professional development courses. There is either no statistically significant differences between the students' average achievements when professional development courses are related to mathematics curriculum, assessment, or use of information technologies in teaching mathematics; or statistically significant difference is in favour of teachers who have not attended professional

development courses in the case of courses related to mathematics content (difference about 23 scale points; F=52.698, p<0.01), and mathematics pedagogy (difference about 8 scale points; F=9.732, p<0.01).

School locality

We found that there are statistically significant differences between the average achievements of students in urban and rural communities. Besides that, the urban communities also differ between themselves: achievements of students from Vilnius were statistically significantly higher than their peers in other cities and towns: in Vilnius students' average achievement was 537 scale points, in other cities and towns – 507, and in the country-side – 473 scale points (based on the Bonferroni test, all differences statistically significant; F=131.550, p<0.01). The χ^2 test also shows a statistically significant relationship between the school locality and the levels of mathematics achievement (χ^2=227.308, p<0.01; for illustration see 2 table).

2 table. Relationship between the school locality and student's level of mathematical achievement

School locality	Levels of mathematics achievements (% of students)					Total
	Low	Minimal	Intermed.	High	Advanced	
Vilnius	2,6	15,2	38,0	35,3	8,9	100
Cities/towns	7,2	26,0	37,6	23,5	5,6	100
Country-side	16,7	35,0	30,5	15,1	2,8	100

References

1. Blau, D.M. (1999). The Effect of Income on Child development. *The Review of Economics and Statistics, 81 (2)*, 261-276.
2. Israel, G.D. et al. (2001). The Influence of Family and Community Social Capital on Educational Achievement. *Rural Sociology, 66 (1),* 43-68.
3. Jensen, B. and Seltzer, A. (2000). Neighborhood and Family Effects in Educational Progress. *The Australian Economic Review, 33 (1),* 17-31
4. Lee, V.E. and Croninger, R.G. (1994). The Relative Importance of Home and School in the Development of Literacy Skills for Middle-Grade Students. *American Journal of Education, 102 (3)*, 286-329.
5. Martin, M.O. et al. (2004). TIMSS 2003 Technical Report, Boston College
6. Mullis, I. et al. (2004). TIMSS 2003 International Mathematics Report, Boston College

7. Thirunarayanan, M. O. (2004). The „Significantly Worse“ Phenomenon: A Study of Student Achievement in Different Content Areas by School Location. *Education and Urban Society*, 36 (4), 467-481.
8. Database of TIMSS 2003, Grade 8.