Thematic Article

The performance of Hungarian minority students in PISA assessments (2003–2022)

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Abstract

The analysis tries to describe the academic competencies of Hungarian minority students in the Carpathian Basin based on international PISA assessments. To this end, the author first addressed some methodological aspects of the PISA assessments and then presented some international data. Although the school competencies of Hungarian youth in Romania, Serbia, and Slovakia, as revealed by PISA data, show a fluctuating picture over time, a few patterns clearly emerge. First, one can see that while in Transylvania it appears that Hungarian students perform better than the majority students, in Slovakia the opposite is true, and in Vojvodina the homogeneity of the school-system is evident, as there is no significant difference here between Hungarian minority and majority youth. Despite the small sample sizes, one can still gain some insight into learning in a non-native language: in Romania and Serbia, this generally results in a disadvantage, but Slovakia stands out as an exception in this regard as well: here, it appears that choosing the majority language carries neither an advantage nor a disadvantage in terms of academic competencies. When interpreting academic performance, however, it is essential to take various background factors into account, primarily family background. The analysis highlights that the index of the socio-economic background of majority and minority Hungarian youth shows significant differences. To measure the net effect of the test language a linear regression model was elaborated. Using this, the author argues that the test language exerts a significant effect in the areas of mathematics and sciences.

Keywords: PISA; school competencies; Hungarian minorities

Problem Statement

In multi-ethnic countries in general, but certainly in Central Europe, how education is organized for minority groups and how it functions are key issues. The educational their participation of minorities as well as their educational attainment indicators are examined by many analyses, and these typically conclude that larger ethnic groups often face structural disadvantages, namely, educational attainment being lower, subsequently resulting in lower employment rates. All of this further highlights that the education system is a specific arena of asymmetrical social relations. Minority education is significant not only in terms of social inequality, but also in relation to the assertion of minority interests and the guarantee of minority rights. In this latter context, the question is whether education can be provided in the minority language, that is, whether members of the minority can use their own native language in education. This using the mother tongue in school is based, on the one hand, on the premise that it is easier to acquire knowledge in one's native language, and on the other, on minority and identity politics' assumption that this is also the key to the reproduction of the minority community.

In my analysis, I focus on how one can find information regarding the academic performance of Hungarian minority students in the PISA (Programme for International Student Assessment) surveys—a series of assessments that has garnered much international interest and is regarded as an educational policy tool. At the same time, building on this assessment toolkit, the challenge lies not only in the international "ranking" of minority Hungarian student performance, but also in determining what interpretations one can offer of the

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measured academic competencies. I will aim to later show that PISA also provides an opportunity to gain insights into the role it plays in the identity-political struggles surrounding minority education.

A Brief Overview of the PISA Assessments

The PISA surveys, conducted every three years by the OECD (Organisation for Economic Co-operation and Development) since 2000, have generated a vast body of literature and have had a meaningful public impact: the data attract considerable attention and spark policy debates. In the public sphere, the ranking of countries usually draws the most attention, but of course, a thorough analysis of the numbers and the reports published on the PISA-OECD website itself provide a much more nuanced picture of the education systems of the countries and regions participating in the survey.

At the beginning it must be noted that the fundamental question of PISA assessments is: "What should citizens know and be able to do?"[2] This question has two critical aspects: first, it refers to citizens (rather than students), and second, it mentions skills (rather than knowledge). All of this means that while the PISA survey targets the school population, it views them as citizens and future employees. Simultaneously, the focus is not on what test-takers know at the lexical level, but rather on what they do with the school-acquired knowledge as future employees.

The specific target group for PISA assessments is 15-year-olds, regardless of the type or level of education they are enrolled in. Since 2000, the assessments have been conducted in three core areas with one of the areas always being examined in greater detail: mathematical literacy, reading literacy, and scientific literacy. In addition to these, based on certain countries' commitments—though not comprehensively and not consistently—other literacy areas have also been measured (in 2022, for example, creative thinking was measured).

Interpreting the data also requires addressing additional principal methodological considerations. Competency assessments, as represented by PISA, belong to a paradigm that, in explaining abilities, do not merely assume school/institutional or school system-level factors, or even individual and/or hereditary traits, but also emphasize the role of family background. For this reason, during the processing of PISA data, various background variables—including a family background index—can be created, and subsequently used to examine the extent to which school performance is determined by these types of background characteristics.

Moreover, PISA studies use a two-stage sampling process, starting with the selection of schools and following with that of the students within. Therefore, the statistics for the total sample are calculated using a special, re-sampling, repeated weighting procedure to obtain more accurate estimates (e.g., variance, statistical error, etc.). This is done using the so-called BRR (Balanced Repeated Replication) method, i.e., the original sample is divided into subsamples, and then the relevant statistics of these subsamples are compared with the statistics of the total sample. In the PISA studies, 80 BRR subsamples are generated.[3]

PISA-based Systemic Challenges of the Countries where Hungarian Minority Education functions

Our analysis focuses primarily on the competency scores of Hungarian minority students living in Romania, Slovakia, and Serbia; however, before proceeding, it is worth examining how the educational systems of these countries rank internationally in PISA assessments (Figure 1 and 2). It is a well-known fact that countries in East Asia perform quite well, that is, significantly above the OECD average. In 2022, for example, Singapore led the list by a wide margin in mathematics (575 points), while the average for OECD countries was 472 points. Seventeen of the OECD countries performed above average, with Estonia (510 points) and Switzerland (508 points) leading the European pack. Hungary ranks as average among OECD countries, while Slovakia, also an OECD member, performed below average, as did Romania and Serbia, which will be examined in more detail in this analysis.

[2] OECD (2023). PISA 2022. (Volume I.): The State of Learning and Equity in Education, PISA, OECD Publishing, Paris. p. 38. DOI: 10.1787/53f23881-en

[3] For detailed methodological and statistical details see OECD 2009.

Figure 1. Mean scores in mathematic performance - OECD countries

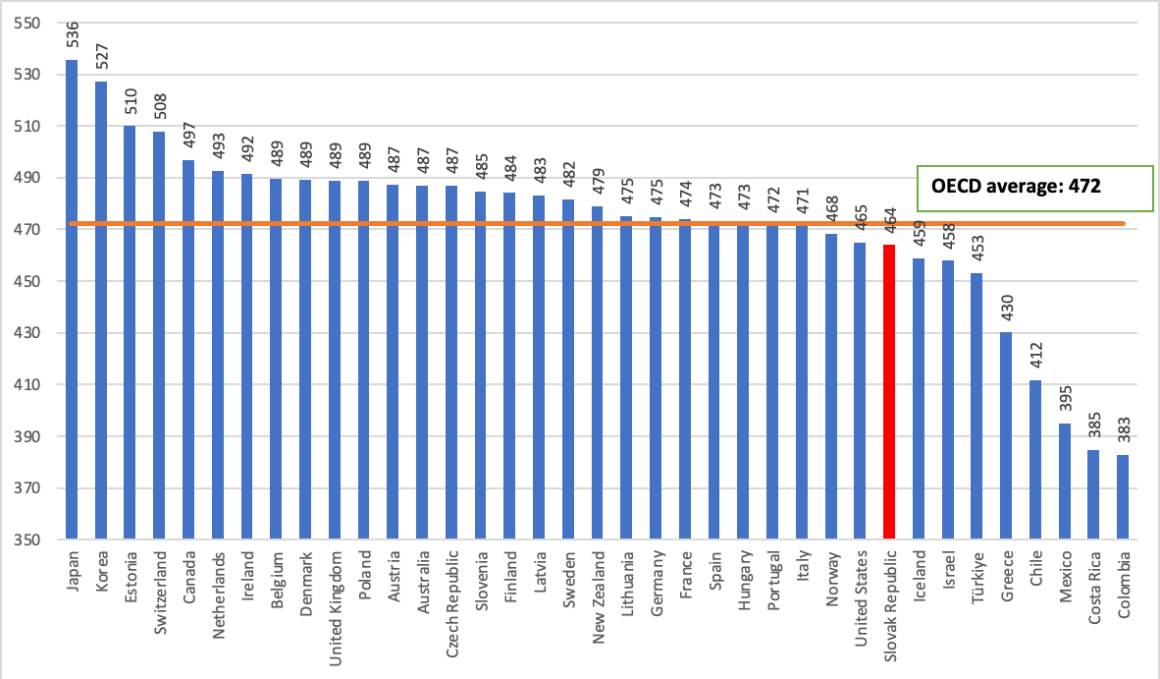
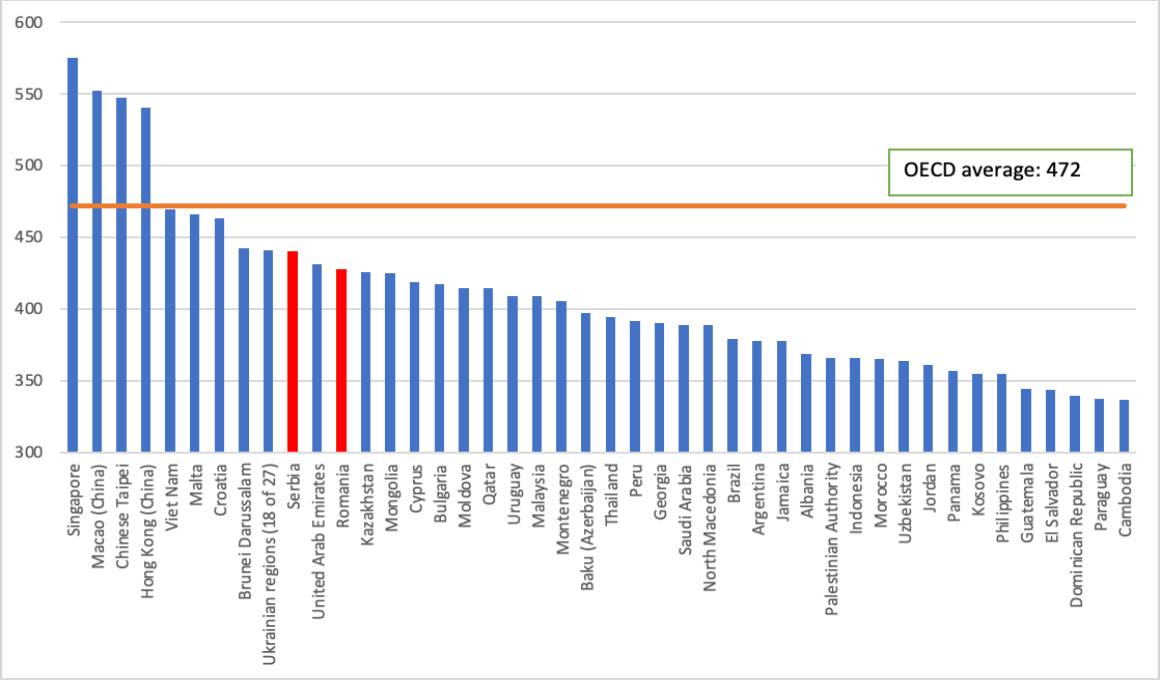


Figure 2. Mean scores in mathematic performance - partner countries



Using proficiency scores, PISA assessments establish what are called “proficiency levels”. Compared to previous practice, 2022 assessments refined and defined mathematics proficiency into eight levels. Level 2 is considered the threshold for proficiency scores: those who reach this level are presumed to be able to recognize mathematical relationships in real-life situations, solve them to some extent, and thus participate in social life as full-fledged citizens. Those who perform below this threshold are highly unlikely to obtain a higher education degree and will likely end up in low-paying jobs and/or positions with lower social prestige. Similarly, proficiency levels have been defined in the areas of reading comprehension (eight levels) and science (seven levels). In all three domains, students who do not reach Level 2 are classified as underachievers, while those who reach Level 5 are classified as high achievers.

At the OECD level, the proportion of underachievers is highest in mathematics (31.9 percent), 26.3 percent in reading, and 24.5 percent in science. In Tables 1, 2, and 3, I have presented the OECD country performance

distributions findings, contrasting the OECD average with that of Hungary and with the neighbors most relevant to Hungarian minority education. With slight variations accounted for across subject areas, one can see that overall Hungary is near the OECD average, Slovakia is slightly below it, and Romania, Serbia, and Ukraine hold the greatest proportions of underperforming students.

Table 1. Proportion of students at different proficiency levels in mathematics (OECD average, Hungary, and selected neighboring countries)

	Mathematics										
	below Level 1c	**Level 1c**	**Level 1b**	**Level 1a**	**Level 2**	**Level 3**	**Level 4**	**Level 5**	**Level 6**	**Level 2 and above**	**under-performing students**
	%	%	%	%	%	%	%	%	%	%	%
OECD average	0,3	2,3	9,8	18,7	23,3	22,0	14,9	6,7	2,0	68,9	31,1
Hungary	0,2	2,4	9,6	17,3	23,8	23,8	15,1	6,3	1,6	70,5	29,5
Slovakia	0,9	4,4	10,9	17,1	22,0	22,6	14,9	5,7	1,6	66,8	33,2
Romania	1,5	7,0	17,1	22,9	22,3	16,4	8,7	3,2	0,8	51,4	48,6
Serbia	0,7	3,6	13,8	25,0	26,3	18,1	8,8	3,0	0,8	56,9	43,1

Source: OECD, PISA 2022 Database, Table I.B1.3.1.

Table 2. Proportion of students at different proficiency levels in reading (OECD average, Hungary, and selected neighboring countries)

	Reading										
	below Level 1c	**Level 1c**	**Level 1b**	**Level 1a**	**Level 2**	**Level 3**	**Level 4**	**Level 5**	**Level 6**	**Level 2 and above**	**under-performing students**
	%	%	%	%	%	%	%	%	%	%	%
OECD average	0,2	1,9	7,6	16,6	24,4	25,3	16,9	6,0	1,2	73,7	26,3
Hungary	0,3	2,0	7,5	16,0	24,4	27,0	17,3	4,9	0,5	74,1	25,9
Slovakia	0,5	3,7	11,3	19,9	25,0	23,0	13,2	3,1	0,3	64,6	35,4
Romania	0,7	4,3	13,6	23,2	26,6	20,6	9,1	1,9	0,1	58,3	41,7
Serbia	0,3	2,0	10,3	23,8	29,7	22,7	9,3	1,7	0,1	63,6	36,4

Source: OECD, PISA 2022 Database, Table I.B1.3.2.

Table 3. Proportion of students at different proficiency levels in science (OECD average, Hungary, and some neighboring countries)

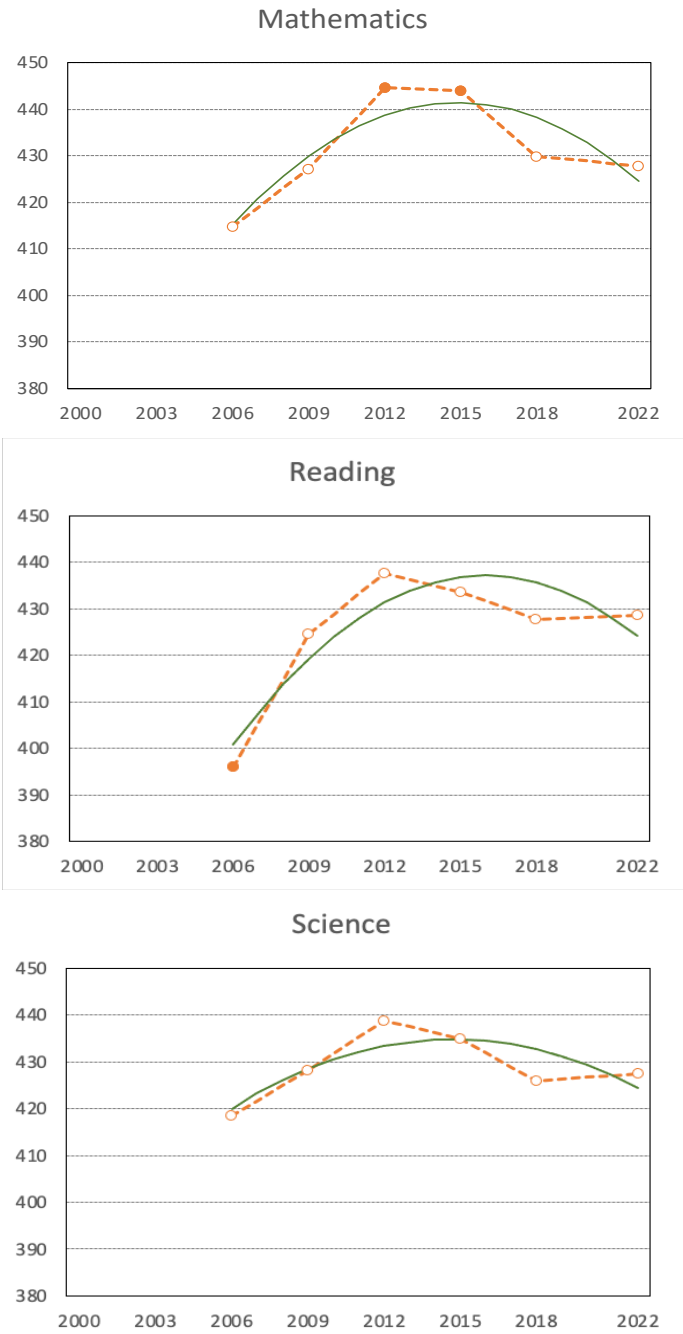
	Sciences									
	below Level 1b	**Level 1b**	**Level 1a**	**Level 2**	**Level 3**	**Level 4**	**Level 5**	**Level 6**	**Level 2 and above**	**under-performing students**
	%	%	%	%	%	%	%	%	%	%
OECD average	1,1	6,3	17,1	25,2	25,7	17,2	6,3	1,2	75,5	24,5
Hungary	0,6	5,5	16,8	25,9	27,3	17,7	5,5	0,6	77,1	22,9
Slovakia	2,6	9,3	18,7	26,3	24,7	14,0	3,8	0,5	69,4	30,6
Romania	3,2	14,9	25,9	27,0	19,6	8,0	1,3	0,1	56,0	44,0
Serbia	1,6	9,1	24,5	30,7	22,5	9,5	2,0	0,2	64,9	35,1

Source: OECD, PISA 2022 Database, Table I.B1.3.3.

For example, nearly one in every two students in Romania underperforms in mathematics (48.6 percent). The situation in Serbia and Ukraine differs little, with the rate of underperforming students standing above 40 percent.

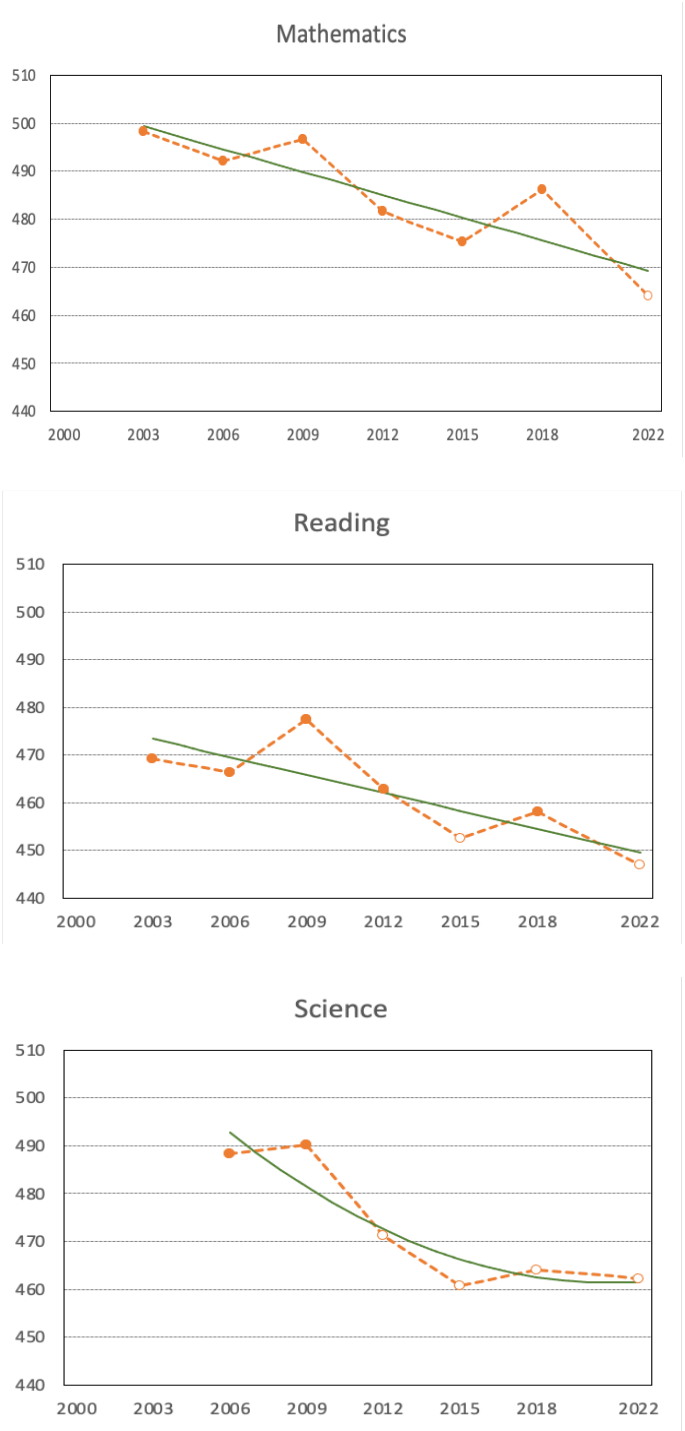
Since the surveys began in 2000, it is possible to outline trends over time based on three-year cycles.

Figure 3. Overview of trends in mathematics, reading and science performance in Romania



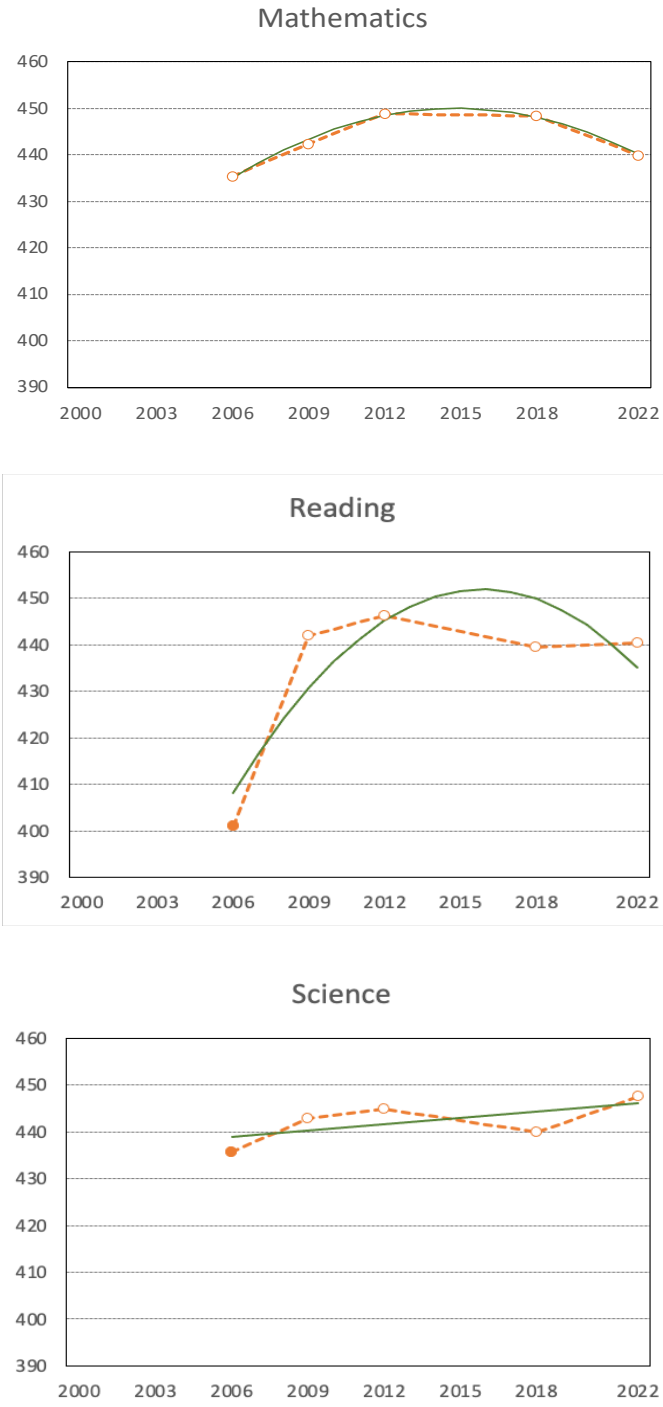
Source: OECD, PISA 2022 Database, Tables I.B1.5.4, I.B1.5.5 and I.B1.5.6.
Note: White dots indicate mean-performance estimates that are not statistically significantly above/below PISA 2022 estimates. Green lines indicate the best-fitting trend line.

Figure 4. Overview of trends in mathematics, reading and science performance in Slovakia



Source: OECD, PISA 2022 Database, Tables I.B1.5.4, I.B1.5.5 and I.B1.5.6.
Note: White dots indicate mean-performance estimates that are not statistically significantly above/below PISA 2022 estimates. Green lines indicate the best-fitting trend line.

Figure 5. Overview of trends in mathematics, reading and science performance in Serbia



Source: OECD, PISA 2022 Database, Tables I.B1.5.4, I.B1.5.5 and I.B1.5.6.
Note: White dots indicate mean-performance estimates that are not statistically significantly above/below PISA 2022 estimates. Green lines indicate the best-fitting trend line.

It can be seen in the above data that proficiency in mathematics, reading, and science (in the countries where Hungarian-language minority education takes place) either trends toward stagnation (Romania, Slovakia) or decline (Serbia). For example, in Romania, students were relatively more successful around 2010, but, following the 2012 assessment, a decline was observed in mathematics and stagnation in reading and science.

When interpreting the characteristics of minority education—which will be discussed in greater detail later—two key points must always be kept in mind: 1) those in Slovakia operate within a relatively more successful education system (for now), and 2) young people in Transylvania (Romania) and Vojvodina (Serbia)

study in a system whose performance, measured at the national level, has been below the OECD average consistently. At the same time, a long-term national trend has come to light showing that Romania and Serbia have largely stagnated over the past 10 years, while Slovakia appears to be in steady decline. Thus, it is particularly important to examine how national factors influence the academic performance of Hungarian students studying in these three countries.

Academic performance of Hungarian minority students in the Carpathian Basin in PISA surveys

The results of PISA assessments are primarily relevant at the national level and, in certain cases, at the regional level, but they also provide an opportunity to interpret in an equity paradigm the data regarding various minority groups.[4]

The Hungarian minority students can be considered a linguistic-ethnic group, and PISA provides an opportunity to gain an international comparative perspective on this group's academic performance. In some previous analysis, potential of PISA assessments regarding minority education (Papp, 2014a; Papp, 2015; Papp 2025) is discussed in detail; here, it is worth mentioning the possibility of measuring the academic performance of minority students by utilizing certain background questions. Knowing the language of the test and what language students speak at home, we can statistically identify the minority group that takes the test in their own language (e.g., participates in mother-tongue education), as well as the group that continues their studies in a language other than their native tongue (e.g., the majority language).

Upon analyzing the competency scores, four major groups took shape. Three of these were defined according to the scheme below (Table 4), while those who identified Hungarian as their home language—regardless of the language in which they study—were uniformly classified as the "Hungarian minority—total" category.

Table 4. Potential majority and ethnic-linguistic minority student groups in PISA

	Test language: majority	**Test language: Hungarian**
Language spoken at home: majority	Students from the majority group who are studying in the majority language *„Majority in majority language"*	Not tipical, rare
Language spoken at home: Hungarian	Hungarian minority students who are studying in the majority language *„Hungarian minority in state language"*	Hungarian minority students who are studying in their mother-tongue *„Hungarian minority in mother tongue"*

The data recorded from the start of the assessment has been compiled in Tables 5, 6, and 7,[5] however, my aim is to focus on the most recent assessment. The data presented here were calculated based on the methodology section, using the statistical procedures employed in PISA (plausible values and replacement weights). By scrutinizing the analysis of the 2022 assessments more carefully, I will also demonstrate what statistical conclusions can be drawn from these assessments and how it can be done.

Table 5 (Romania/Transylvania) shows the competency scores of the statistical (majority and minority) groups created using the aforementioned method. Those in the majority-majority language category largely follow the national trend shown in Figure 4. In mathematics, for example, one can see here that no substantial (statistically significant) shift occurred between 2006 and 2022, as, although the scores were relatively high around 2012–2015, they dropped significantly after 2015. Interestingly enough, COVID-19 did affect a decline in this area. Students belonging to the Hungarian minority show some overall improvement in mathematical competence after 2006, but even in their case, no statistically significant difference emerged since 2009. Examining students studying in Romanian separately within the Hungarian youth population, it appears that they generally achieve lower proficiency scores; however, it is important to note that the sample size for this group is relatively small, and therefore the margin of error is quite high. Nevertheless, the data measured in 2022 (454 points for students studying in Hungarian and 376 points for those studying in the official language)

[4] „A fair education system gives students with an immigrant background an equal opportunity to thrive at school and realise their full learning potential" OECD 2023. 206.

[5] It is clear that the countries did not all begin participating in the PISA assessments at the same time, nor did they take part in every assessment. In 2022, all three countries participated, and in this paper I will examine the relevant data in greater detail.

convincingly[6] indicate that learning in the mother tongue is more effective. Based on this 2022 data, it can be concluded that students in Hungarian-language schools performed significantly better[7] in mathematics than their Romanian peers.

Based on data for the national average and Romanian students, in reading comprehension, there was a slight increase in children's proficiency between 2006 and 2022 (from 392 points— quite low by international standards—to 430), with minor fluctuations between 2009 and 2018, which can easily be perceived as stagnation. Hungarian students are no exception either, particularly those attending Hungarian-language schools: scores rising from 406 (2006) to 447 (2022). It must also be noted that continuous decline was also observed starting from 2009. The question here, too, is whether the 430-point score of Romanian students and the 447-point score of those attending Hungarian-language schools, taking into account statistical margins of error, indicate a significant difference? The answer is yes, because one can state with 100% certainty that the averages differ from one another.8 At the same time, it is also easy to see that, in reading comprehension as well, students learning in a non-native language perform significantly worse than those learning in their native language.

Finally, one can draw similar conclusions regarding science competencies: on the one hand, there has been no significant change over time for majority students since the first assessment, and for Hungarian minority students since 2009 (with only a slight positive shift compared to 2006). The 2022 data further highlight here that Hungarian students in general, and those attending Hungarian schools, perform significantly better than Romanians, while it is evident among Hungarian students learning in a language not their own that they lag significantly behind.

Table 5. Changes in mean scores by language spoken at home and test language (Romania, 2006–2022)

	ROMANIA – mathematics						
	2006	**2009**	**2012**	**2015**	**2018**	**2022**	**SE**
Majority in majority language	416	424	445	445	432	428	4,2
Hungarian minority – TOTAL	410	456	439	438	452	445	7,6
Hungarian minority in mother tongue	427	492	445	439	462	454	7,2
Hungarian minority in state language	390	387	404	426	411	376	25,7
	ROMANIA – reading						
	2006	**2009**	**2012**	**2015**	**2018**	**2022**	**SE**
Majority in majority language	392	423	438	433	428	430	4,2
Hungarian minority – TOTAL	378	458	444	443	458	439	8,1
Hungarian minority in mother tongue	406	504	456	445	473	447	8,1
Hungarian minority in state language	346	357	367	418	400	381	24,3
	ROMANIA – science						
	2006	**2009**	**2012**	**2015**	**2018**	**2022**	**SE**
Majority in majority language	416	425	438	432	426	428	4,0
Hungarian minority – TOTAL	417	473	455	467	452	456	7,3
Hungarian minority in mother tongue	440	515	466	472	469	466	7,3
Hungarian minority in state language	391	381	389	414	384	386	19,6

[6] t-value: 2,89. df.: 1207; sig: 0.004.
[7] t-value: 8,36. df.: 7005; sig: 0.000.
[8] t-value: 5,54. df.: 7005; sig: 0.000

The mathematics proficiency scores of majority youth in Vojvodina/Serbia appear to have risen somewhat over the approximately 20 years since they began participating in the PISA assessment, but this increase is not statistically significant. The education system there seems to be homogeneous as no great difference can be detected between majority and minority students in 2022. What is more, it cannot be concluded with statistical certainty that, within the Hungarian group, students learning in a language other than their native tongue perform significantly worse in mathematics. This is deduced from the lack of stark difference between the Hungarians-in-state-language competency score (390) and the Hungarians-in-mother-tongue point average (423).[9]

As regards the reading comprehension skills of Serbian students learning in Serbian, improvement was seen in 2009, followed by stagnation or slight fluctuations. Hungarian students also experienced increase but, unlike their Serbian counterparts, remained stable until 2018. Serbian students (learning in Serbian), similar to Romanian students (in their mother tongues), appear to have been little impacted by the pandemic. However, based on the data, it appears that students learning in Hungarian were negatively affected by the COVID-19 period, as their reading comprehension scores dropped significantly by 2022 (from 474 in 2018 to 428). They, in this way, are in line with national trends, as by 2022 no meaningful difference exists between young people taking the test in Hungarian and those taking it in Serbian.[10]

In sciences, Serbian students are the most consistent; while there has been a slight increase compared to the first assessment, school performance in this area has remained stable since 2009. Students attending Hungarian-language schools appeared to perform better in this area over the past two decades, particularly in the early 2000s, but these differences have now completely evened out. In this regard, the real losers are Hungarian youth studying in the state language, who find themselves far behind students studying in Hungarian, and generally speaking, compared to national averages as well.[11]

[9] t-value: 1.535; df.: 159; sig: 0.127.
[10] The mean for the former is 428 and for the latter 443, but the difference between the two is not statistically significant in the strict sense (p=0.05): t-value: 1.955; df.: 6158; sig: 0.051.
[11] t-value: 3.318; df.: 159; sig: 0.001.

Table 6. Changes in mean scores by language spoken at home and test language (Serbia, 2003–2022)

	SERBIA – mathematics						
	2003	**2006**	**2009**	**2012**	**2018**	**2022**	**SE**
Majority in majority language	437	436	443	449	450	443	2,9
Hungarian minority – TOTAL	437	444	440	477	471	419	8,1
Hungarian minority in mother tongue	437	446	443	485	484	423	9,3
Hungarian minority in state language	445	432	426	468	364	390	19,0
	SERBIA – reading						
	2003	**2006**	**2009**	**2012**	**2018**	**2022**	**SE**
Majority in majority language	412	403	443	447	441	443	2,7
Hungarian minority – TOTAL	408	408	457	484	460	419	9,7
Hungarian minority in mother tongue	408	415	466	494	474	428	11,6
Hungarian minority in state language	408	366	424	471	342	360	18,1
	SERBIA – science						
	2003	**2006**	**2009**	**2012**	**2018**	**2022**	**SE**
Majority in majority language	436	436	443	444	440	450	2,8
Hungarian minority – TOTAL	443	459	458	485	468	444	11,6
Hungarian minority in mother tongue	443	463	464	489	479	453	12,2
Hungarian minority in state language	443	435	441	482	379	384	18,2

Source: own calculations based on PISA student databases

National-level data, as well as the data in Table 7 for Slovak youth studying in Slovak (majority–majority language category), indicate that mathematical proficiency levels declined significantly between 2003 and 2022. COVID-19 has left a significant mark on Slovakia, as the country is among those where student performance declined significantly between the last two assessments.

The mathematical performance of Hungarian students has shown a steady decline since 2003: while 480 points were recorded in 2003, this figure dropped to 427 by 2022. The same trend applies to students attending Hungarian-language classes (who take the tests in Hungarian). According to the 2022 data, it can also be stated that Hungarian students (regardless of the language in which they study) perform significantly lower than the majority of students—those studying in Slovak. This gap is also clearly evident in the other two competency areas.

It is also important to emphasize that in Slovakia, students studying in a language other than their native language cannot be considered "losers"; their competency scores do not differ significantly from those of students studying in their native language. Taking into account the statistical margin of error in the averages, based on the 2022 data, this observation holds true for all three areas: in mathematics and science, it is "obvious at a glance" that the averages do not differ significantly, but in reading comprehension, the average of 424 for native-language instruction also does not differ significantly from the average of 397 for students who do not study in Hungarian (but speak Hungarian at home).[12]

[12] t-value: 1.301; df.:424; sig: 0.194.

Table 7. Changes in mean scores by language spoken at home and test language (Slovakia, 2003–2022)

	SLOVAKIA – mathematics							
	2003	**2006**	**2009**	**2012**	**2015**	**2018**	**2022**	**SE**
Majority in majority language	508	503	503	493	487	500	478	3,2
Hungarian minority – TOTAL	480	464	469	462	446	453	427	12,0
Hungarian minority in mother tongue	486	480	458	465	454	450	429	17,0
Hungarian minority in state language	457	431	487	452	427	463	423	11,2
	SLOVAKIA – reading							
	2003	**2006**	**2009**	**2012**	**2015**	**2018**	**2022**	**SE**
Majority in majority language	479	478	485	476	467	471	460	3,4
Hungarian minority – TOTAL	455	456	446	441	422	426	414	12,2
Hungarian minority in mother tongue	466	493	447	447	435	430	424	17,1
Hungarian minority in state language	421	382	444	414	392	414	397	11,8
	SLOVAKIA – science							
	2003	**2006**	**2009**	**2012**	**2015**	**2018**	**2022**	**SE**
Majority in majority language	506	499	498	483	474	476	477	3,2
Hungarian minority – TOTAL	483	463	463	458	428	430	419	11,4
Hungarian minority in mother tongue	492	491	460	466	441	433	408	12,6
Hungarian minority in state language	452	409	467	429	399	422	426	16,2

A Model Explaining Academic Performance in a Minority Context

Numerous factors may underlie differences in academic performance: from individual predispositions to weather-related challenges, as well as logistical and organizational factors, all of which can influence current outcomes. In the sociological literature on education, the role of family background and cultural capital—which often operates in hidden ways—is frequently emphasized (Coleman et al., 1966; Bourdieu & Passeron, 1990).

As previously mentioned, in the symbolic school struggle between the majority and the minority, the three countries examined show different patterns based on the 2022 data presented. While Hungarian schools appear to be more successful in Romania, the data from Slovakia suggest that Hungarians or students studying in Hungarian are at a "disadvantage." In Serbia, however, it was found that the system as a whole is fairly homogeneous, which also means that there is no difference in competency levels between Serbian and Hungarian students. Based on my analysis, therefore, the extent to which the academic performance of minority students is affected by their family background and, independently, by language of instruction was sought out.

Table 8 presents the PISA index of economic, social, and cultural status (ESCS) of all three examined countries along with Hungary. One can see that Hungary is at the OECD average level, while the other countries, including Slovakia (also an OECD member), show below-average values. Accepting the fact that this background has an impact on school performance, it is not surprising that Hungary performed on par with the OECD average, while Romania and Serbia remained below it. What is interesting, however, is that Slovakia, despite having a family background index value well below the average, does not perform substantially worse than the average, while surpassing Serbia and its higher ESCS value.

Table 8. PISA index of Economic, Social, and Cultural Status (ESCS)

	ESCS	Standard Error SE	Standard Deviation SD
OECD	0.00	(0.00)	0.91
Hungary	0.00	(0.02)	0.96
Slovakia	-0.30	(0.02)	0.96
Romania	-0.36	(0.04)	1.03
Serbia	-0.20	(0.02)	0.84

From the perspective of the present study, however, I strive to determine whether the linguistic minority groups identified in PISA are also socially stratified. In other words, I will examine the ESCS index according to both the language spoken at home and the test language in focus in each of the three countries (see Table 9). In all three cases, the family backgrounds of majority students and students attending Hungarian-language classes differ significantly from one another, but not in the same way. While in Romania the family background of Hungarian youth appears to be significantly more favorable compared to that of the majority,[13] in Serbia and Slovakia Hungarians have a less favorable social positioning. Furthermore, only in the case of Serbia can it be concluded that there are differences among Hungarians: Hungarian youth participating in mainstream education seem to have a more favorable family background.

Table 9. ESCS Index for Romania, Serbia, and Slovakia by Language Spoken at Home and Test Language (PISA 2022)

	Romania		Serbia		Slovakia	
	ESCS	SE	ESCS	SE	ESCS	SE
Majority in majority language	-0,37	(0,04)	-0,18	(0,01)	-0,20	(0,03)
Hungarian minority - TOTAL	-0,15	(0,07)	-0,66	(0,09)	-0,45	(0,11)
Hungarian minority in mother tongue	-0,12	(0,06)	-0,72	(0,09)	-0,50	(0,14)
Hungarian minority in state language	-0,38	(0,32)	-0,29	(0,16)	-0,37	(0,16)

Source: own calculations based on the PISA 2022 student database

PISA reports typically provide detailed information on the impact of ESCS on school performance. The 2022 report reveals that, across OECD countries, 15 percent of mathematics performance is influenced by students' family background. This indicator is lowest in Serbia (13 percent), which is not surprising, due to the fact that this education system appeared to be the most homogeneous in terms of school performance as well. In Slovakia and Romania, family background accounts for approximately 25 percent of mathematical performance.

The educational system's ability to level the playing field is also indicated by the extent to which a one-unit change in the ESCS results in an increase in ability scores (this is the B value, which indicates the slope of the linear regression estimate). At the OECD level, this amounts to 39 points, and it is highest in Slovakia (and internationally) with 53 points.[14]

To determine whether Hungarian-language education is more successful or not, it is necessary to expand the model with a dummy variable (TEST_LANGUAGE_D) indicating the test language: 0 refers the majority language and 1 indicates the Hungarian language. Mathematical competence = Constant + ESCS*B1 + TEST_LANGUAGE_D*B2; where: ESCS – family background index; B1 – net effect of family background; B2 – net effect of language of instruction

In this model, the values next to the test language variable (marked with B2) point to the so-called net effect, i.e., effects measurable independently of family background. We can see (Table 10) that this effect is not significant everywhere, meaning that the language of instruction does not substantially "add to" (or "take away from") the estimate that already accounts for family background. Reading comprehension, for example, is influenced by family background, but the language of instruction has no significant independent effect in any of the countries studied. However, it appears that Hungarian-language schools in Transylvania/Romania have significantly contributed to the development of mathematical skills; in contrast, the mathematical competencies

[13] This is somewhat surprising, given that a minority PISA subsample was created in Romania in 2022. Other surveys do not typically show such discrepancies.

[14] For detailed, country-level data see PISA 2022 TableI.B1.4.3.

of students in Hungarian-language education in Slovakia do not improve (but rather weaken) because of participating in this form of education. In Serbia/Vojvodina, the language of instruction has no independent effect on mathematical competencies reinforcing this system's greater homogeneity regarding language of instruction contrasted with the other two nations. A similar pattern in science competencies regarding Transylvania and Slovakia has been observed; in Vojvodina, however, it appears that mother-tongue instruction—similar to Transylvania—also has a positive effect.

Table 10. Coefficients of linear regression models based on the PISA 2022 database

		Mathematics		**Reading**		**Science**	
CNTRYID	EqVar	**B**	**beta**	**B**	**beta**	**B**	**beta**
Romania	(CONSTANT)	445		445		443	
	ESCS	48	0,51*	46	0,47*	45	0,49*
	TEST_LANGUAGE_D *(0 - majority; 1 - Hungarian)*	**14**[a]	0,03*	6	0,01	**27**[a]	0,06*
Serbia	(CONSTANT)	448		448		455	
	ESCS	39	0,37*	36	0,33*	38	0,35*
	TEST_LANGUAGE_D *(0 - majority; 1 - Hungarian)*	4	0,01	5	0,01	**25**[a]	0,04*
Slovakia	(CONSTANT)	482		463		481	
	ESCS	53	0,50*	47	0,43*	55	0,51*
	TEST_LANGUAGE_D *(0 - majority; 1 - Hungarian)*	**-28**[b]	-0,06*	-18	-0,04	**-30**[b]	-0,07*

*significant effect at the p=0.05 level
[a]The average competency score of students learning in Hungarian would be this many points higher if majority and minority students had the same ESCS score.
[b]In absolute terms, the average competency score of students learning in Slovak would be this many points higher if majority and minority students had the same ESCS score.

All things considered, to determine whether minority-language education or majority-language education is more effective, it is not sufficient to examine merely average competency scores, since family background (as a primary player) and the language of instruction at school (as a lesser factor), along with other unidentified factors, hold important background roles. In Romania, though the math performance of students attending Hungarian-language schools (454 points) was found to be much higher than that of their Romanian peers (428 points), taking student family background (ESCS value) into account, it becomes clear that this difference is due to these differing ESCS values (which is -0.37 for Romanians and -0.12 for those in Hungarian-language schools) and the language of instruction.

By using the regression model we can calculate the explanatory power of mother-tongue education in specific competency areas. Table 11 below shows that in mathematics, the difference between majority and minority students is explained by the language of instruction. In Slovakia, this difference reaches 57 percent, while Transylvania boasts a mere 54 percent. Meanwhile, another aspect that contributes to the difference is the use of the majority language. In the field of natural sciences, the language of instruction accounts for 71 percent of the differences between majority and minority averages in Transylvania and 44 percent in Slovakia. Even so, must be noted that in the former case, the Hungarian language of instruction provides an advantage (measured in terms of competency scores), while in the latter, the Slovak language of instruction does.

Vojvodina is a special case in this regard, as the benefit of the Hungarian language of instruction here is 25 points, yet the differences between the averages indicate only a 3-point gap. In this region, though the ESCS is quite low among Hungarians (-0.72), the compensatory power of the native language fully overrides the family background disadvantages (thus the 100 percent explanatory power). In other words, although there is no difference in the averages between participants in majority-language and Hungarian-language education in Vojvodina, Hungarian-language education has a significant effect on the development of science competencies.

Table 11. Competency averages for majority and minority groups, and differences according to regression coefficients

					What percentage does that account for?	
	Majority in majority language	**Hungarian minority in mother tongue**	**Difference**	**B (test language)**	***test langugae***	***ESCS***
	Mathematics					
Romania	428	454	26	14	**53,8**	**46,2**
Serbia	443	423	-20	4	-20,0	80,0
Slovakia	478	429	-49	-28	**57,1**	42,9
	Reading					
Romania	430	447	17	6	35,3	64,7
Serbia	443	428	-15	5	-33,3	66,7
Slovakia	460	424	-36	-18	50,0	50,0
	Science					
Romania	428	466	38	27	**71,1**	**28,9**
Serbia	450	453	3	25	**100,0**[a]	
Slovakia	477	408	-69	-30	**43,5**	**56,5**

Note: Numbers highlighted in bold indicate a significant effect
[a]Serbia's science score is 100 percent because the B value is greater than the difference: participation in mother-tongue education completely offset the disadvantages caused by the family background index.

Summary

In summary, I attempted through this analysis to describe the academic competencies of Hungarian minority students in the Carpathian Basin based on international PISA assessments. To this end, I firstly addressed some methodological aspects of the PISA assessments and then presented some international data. This was necessary, on the one hand, because when interpreting PISA data one must be aware of the frameworks arising from specific methodological procedures; on the other hand, the scores of the minority target groups of interest to us are also relevant in an international context.

In the most recent 2022 assessment, the Romanian and Serbian education systems, which provide schooling for larger Hungarian minority groups abroad, perform below the level of international OECD countries, while Slovakia performs around the OECD average. While a separate Hungarian sub-sample was surveyed in Romania during the most recent assessment, this was not done in the other two countries; however, students studying in Hungarian also took the tests. Due to the relatively smaller sample sizes in the case of Serbia and Slovakia, as well as in Romania's earlier (pre-2022) assessments, the results should be interpreted with a higher margin of statistical error; nevertheless, it is still possible to analyze time-series data. Moreover, the background data from the PISA assessment also allow us to gain some insight into the abilities of Hungarian youth learning in a language other than their native tongue.

Although the school competencies of Hungarian youth in Romania, Serbia, and Slovakia, as revealed by PISA data, show a fluctuating picture over time, a few patterns clearly emerge. First, it is essential to account for a significant country effect, as the results of Hungarian students vary across different educational systems. While in Romania Hungarian students perform better than the majority, the opposite is true in Slovakia. In Serbia the homogeneity of the school-system is evident, as there is no great difference between Hungarian minority and majority youth. Despite the small sample sizes, it is still possible to see what learning in a non-native language is like. Romania and Serbia are generally at a disadvantage, but Slovakia stands out as an exception where choosing the majority language is neither an advantage nor a disadvantage in terms of academic competencies.

When interpreting academic performance, however, it is essential to take various background factors into account. The index of the socio-economic background of majority and minority Hungarian youth was found to shows significant differences: in Transylvania, Hungarians appear to be better off, while in the other two countries, the majority groups appear on bettering footing. To measure the net effect of the test language independent of family background, a linear regression model was established. Using this, I determined that the test language exerts a significant effect in the areas of mathematics and natural sciences: in Transylvania and Vojvodina, taking the tests in Hungarian confers an advantage regardless of family background, while in

Slovakia, it appears to be associated with disadvantage. It is interesting to note, however, that the test language does not have a significant net effect on reading comprehension in any of the regions, which may be due to the fact that this competency is developed to the same extent in both majority and minority schools/classes.

I think the main message of our study is, having demonstrated that PISA assessments are suitable for providing information regarding minority education, a more detailed explanation of the results would go beyond the scope of this study. I am aware that the effectiveness of minority education has, or may have, numerous implications for minority policy and education policy. One might distinguish between macro, meso, and micro levels. Macro would focus on general minority policies by individual country, on the political and social self-organization of minorities, and on the specific characteristics of education policy, while the meso level might hone in on institutional and even territorial opportunities. Micro would take into account individual and family decisions, characteristics, and interactions. (Papp, 2010)

A recent study (Kiss & Toró, 2025) also offers macro-level explanations for the differing academic performance of minority and majority students. In their discussion of the macro level, the authors conceptualize minority education in four models depending on the type of education policy associated with minority policy: 1) integration, 2) assimilation, 3) accommodation, and 4) ethnic/majority hegemony. The PISA database itself provides an opportunity to examine the individual and institutional levels. An analysis focusing on Hungarians in Slovakia (Papp, 2025), for instance, revealed that minority students exhibit stronger school attachment and lower rates of bullying and absenteeism. Interestingly, despite this, minority students underperform in this country, even after controlling for family background.

It is the impact of family background at the individual level that was the subject of this analysis, during which we explored its interaction with the symbolic struggle unfolding in the social field surrounding minority-majority education. While minority elites advocate for mother-tongue education, the minority policy system exhibits varying nuances and does not always support the entire spectrum of minority education. While our analysis may provide data for interpreting this symbolic struggle, it also highlights that the benefits of the mother tongue, independent of family background, cannot be demonstrated in every single area of competence or in every country. A more detailed exploration of this would require further analysis.

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