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STAY HOME, STAY BEHIND?

Commentary 2/2024

Development of educational inequalities and the impact of the COVID-19 pandemic on school performance

The COVID-19 pandemic has significantly influenced face-to-face learning in Slovakia. Longer distance learning did not have a clear negative impact on school performance on standardised tests (Testovanie 5, Testovanie 9, matriculation). We observe negative impacts mainly on T9 where the impact varies based on school type. Whereas 8-year grammar schools' results on T9 did not change with longer distance learning, elementary schools' results suffered significantly. On the other hand, longer distance learning is associated with an improvement in school performance on English matriculation exam at B2 level. On other tests, the impact is small or ambiguous. We identify a trend of increasing inequalities in pupil performance. Pupils from socially disadvantaged backgrounds and children of parents with lower educational attainment are falling further behind. We propose a number of recommendations to prepare for future crises and to better monitor the state of Slovak education.

This paper has been translated using AI. Translation of graphs is included in the graphs' description. The document has not been professionally proofread.

The COVID-19 pandemic has radically affected education worldwide for more than two years and Slovakia was no exception. Classes at all levels of education were limited and Slovak schools were closed for longer - from May 2020 to March 2022, primary and secondary schools in Slovakia were "closed" or "partially closed" for 38 weeks, while the average for developed European countries was 30 weeks (UNESCO, 2022).

The pandemic has had a negative impact on pupils' knowledge in most countries. The impact of COVID-19 on educational outcomes has been the subject of hundreds of studies and several so-called meta-analyses, which summarise the findings from many studies at once with respect to their quality (Betthäuser et al., 2023; di Pietro, 2023; König & Frey, 2022; Patrinos et al., 2022; De Witte & François, 2023). These studies agree that pupils' knowledge has on average deteriorated in most of the countries studied. There is consensus that pupils' knowledge suffered more in mathematics than in reading, but researchers disagree, for example, on whether pupils' age played a role. The impact of the pandemic may have been worse in countries that faced longer school closures, which includes Slovakia. Zhdanov et al. (2022) identify a number of potential reasons why the pandemic somewhere led to a loss of knowledge. Distance learning may have been less effective, pupils were less supervised in their learning, received less feedback, and some did not have good access to learning, e.g. they did not have the necessary digital equipment. In addition, pupils spent less time learning during the pandemic, e.g. doing homework, and learning may have been exacerbated by emotional problems caused by the pandemic, such as an increase in anxiety and depression.

The impact of the pandemic may have been worse in countries that faced prolonged school closures.

But the impact of pandemics has not always been fundamentally negative. Pupil performance in some countries has remained at comparable levels. This is true for Australia, Denmark, France or Sweden (Patrinos et al., 2022, p. 14). Even the authors of PISA, which regularly tests and compares the knowledge of pupils in dozens of countries around the world, do not find a clear difference in the 2022

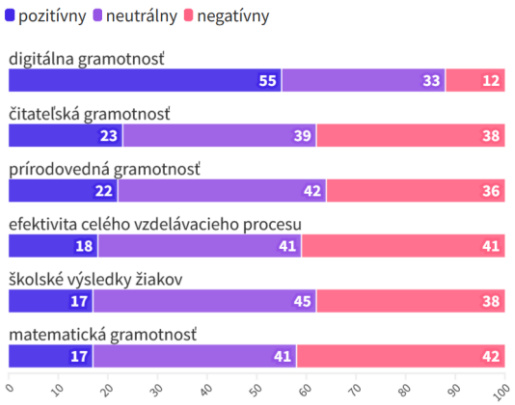
testing between education systems according to the length of the restriction of full-time education. The historical drop in results can only be partly attributed to the pandemic (OECD, 2023a).

Little is known about the impact of the pandemic on pupil outcomes in Slovakia. None of the cited meta-analyses include information on Slovakia. We know from several representative surveys, either among parents or teachers, that the impact of the pandemic on pupils' knowledge was perceived negatively during the pandemic (Ostertágová & Čokyna, 2020; Ostertágová & Rehúš, 2021; Mullis et al., 2023). For example, up to 85% of second grade primary school teachers reported that distance learning resulted in less learning for their students. After the pandemic, however, views on the negative impacts have moderated. In the most recent survey from Slovakia in 2023, which covered both primary and secondary schools, neither teachers nor parents were inclined to think that distance learning had had a negative impact on pupils' performance with hindsight (Figure 1). 38% of teachers considered the impact on pupils' school performance to be negative and the remaining 62% either neutral or positive. Regarding parents' attitudes, the authors of the study note: "*about as many parents perceived a positive change in their pupils' perception of distance learning as perceived a change for the worse*" (Mentel et al., 2023, p. 11). Thus, the surveys do not offer a clear-cut answer about the effects of the pandemic on pupil outcomes. Moreover, their weakness is that they do not directly measure impact, they only map perceptions of impact.

In international testings, Slovak pupils' outcomes sometimes (not always) worsened during the pandemic. It may not be just the impact of the pandemic. Unlike surveys, these tests directly measure the pupils' knowledge and skills and allow for comparisons of results before and after the pandemic. One of the tests is PIRLS, which looks at reading literacy and is written by primary school pupils in Year 4. In the pandemic-affected year 2021, despite expectations, pupils' performance on this test was not statistically different from their performance in 2016 (Mullis et al., 2023, p. 41). The second test is PISA, aimed at testing the reading, mathematics and science literacy skills of 15-year-olds. Slovak pupils participated in 2022 and previously in 2018. On two of the tests (mathematics and reading), pupils deteriorated by a statistically significant level, indicating a possible negative impact of the pandemic on pupils' knowledge (OECD, 2023b). On the other hand, results in science literacy have not statistically worsened, other factors also influence the development of results and, in general, the results of Slovak pupils on PISA tests have been worsening over the long term. Even the results of international testing do not offer us a clear answer on the impact of the pandemic on the results of pupils in Slovakia.

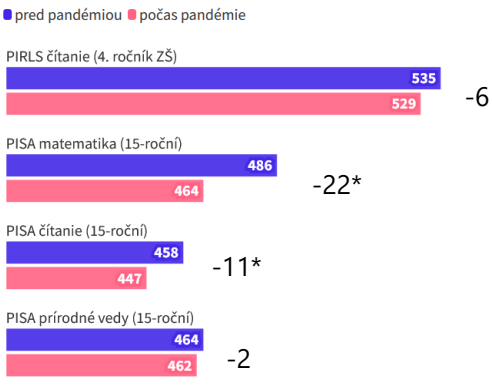
After the pandemic, however, views on the negative impacts have moderated.

Chart 1: Perceived impact of distance learning on pupils' performance by teachers in the Slovak Republic (%)



Source: Mentel et al. (2023, p. 13). A representative sample of 925 teachers participated in the survey between January and March 2023. Teachers rated impacts on a scale of 1 (best impact) to 5 (worst impact). 1-2 were considered positive, 3 neutral and 4-5 negative. Blue stans for positive, violet for neutral and red for negative impact. The bars depict (from top to bottom) digital literacy, reading literacy, science literacy, effectiveness of educational process, school results of pupils, mathematical literacy.

Chart 2: Changes in the results of Slovak pupils on international tests



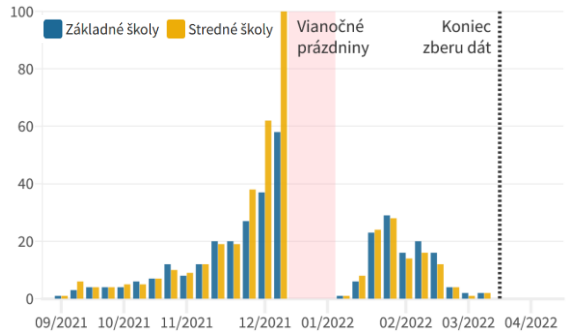
*Source: Mullis et al. (2023, p. 41) and OECD (2023b, p. 155). * indicates statistically significant differences. The bars depict (from top to bottom) PIRLS reading (4th year of elementary school), PISA mathematics (15-year-olds), PISA reading (15-year-olds) and PISA science (15-year-olds).*

This analytical commentary helps to map the impact of the pandemic on Slovak education system. Although schools were also closed in the 2019/2020 and 2020/2021 school years, due to limited data availability, this commentary focuses only on mapping distance learning in the 2021/2022 school year. We examine the impacts in regular primary and secondary schools and on the standardized tests that students wrote this year (Testovanie 5, Testovanie 9, and the matriculation exam). We do not address other, but equally important, impacts of the pandemic on education (mental health, social relationships, and so on).

Schools were to remain open across the board

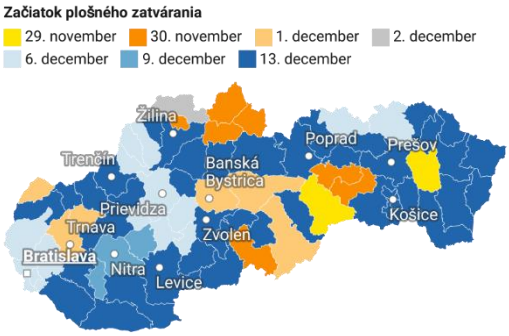
In the 2021/2022 school year, school operations were governed by the so-called COVID Traffic Light[1] and School Traffic Light. These introduced automatic measures depending on the evolution of the epidemiological situation. Primary and secondary schools were to remain open across the board regardless of the severity of the situation in the district. Only individual pupils and classes were to switch to distance learning, e.g. when a class tested positive for COVID-19. Since the beginning of the school year, the proportion of pupils who were distance educated, i.e. either infected, quarantined or switched to distance learning due to class or school closure, has been increasing (Figure 3). While at the beginning of the school year only a minimum of pupils were distance learners, by the end of November it was already about a third. However, schools did not close across the board (district-wide) in September, October, and most of November.

Chart 3: Proportion of pupils in distance learning during the school year 2021/2022 (%)



Source: Education Policy Institute (2024), based on data from the Ministry of Education. Part of the missing data has been imputed (Appendix 3). Blue columns depict elementary schools and yellow bars high schools. Red zone on the graph depicts Christmas Break and a vertical dotted line end of data collection.

Figure 4: Blanket closures of primary and secondary schools at the end of 2021



Source: Education Policy Institute (2024) based on the website ucimenadialku.sk. Schools were closed by decision of the RÚVZ, with the exception of 13 December, when they were closed by decision of the government. The colours depict the beginning of area closures.

Some pupils spent three weeks in distance learning, others only one.

In dealing with the pandemic, policy makers balanced public health protection with other priorities such as the economy, education, and social life. One controversial public health policy that was balanced against the right of students to education was the blanket closure of schools, i.e. the restriction of full-time classes in all schools under the jurisdiction of the Regional Public Health Offices (RÚVZ). They had the power to close schools in order to reduce the mobility of people, limit the spread of the virus and relieve the health system.

At the end of November, regional health officials in some districts began to close all secondary schools and the second cycle of primary schools in their jurisdiction (Figure 4). In the last week of November 2021 (November 29 - December 5), schools were closed across the board by RÚVZ in 9 districts, and in the first week of December (December 6 - December 12) in another 32 districts. Thus, in about half of the districts, the RÚVZ proactively reduced attendance, while in the other half attendance continued. In the second week of December (13.12. - 19.12.), due to a government

[1] The COVID Traffic Light system evaluated the situation on a 5-level colour scale from green (best) to orange, red, violet, to black (worst). The colour of a district was determined by the 7-day case incidence rate, the district's vaccination coverage and the assessment of the RÚVZ, which could change the district's classification by 1 grade in certain circumstances. See more at: https://korona.gov.sk/covid-automat-na-slovensku/

decision, primary and lower secondary schools in all districts were closed across the board. On 20 December, pupils started an early Christmas vacation, from which they returned to their school desks on 10 January. Teaching in December therefore varied from district to district. Some pupils spent three weeks in distance learning, others only one.

Distance learning was more common among pupils in larger schools. The results of the statistical model, a multilevel linear regression, show that the average proportion of pupils in distance learning at school depended on several factors. Unlike comparing averages or other descriptive statistics, this model tells us more about the influence of individual factors, as it also takes into account the influence of other variables and the hierarchical structure of the data, which may bias the effects. The model shows that schools with a higher proportion of pupils from socially disadvantaged backgrounds were less likely to be distance learning, and that state primary schools were slightly more affected by restrictions on face-to-face education than church and private schools. For secondary schools, the situation does not differ significantly by the school type. After controlling for school size, the size of the municipality is not clearly related to the rate of distance learning at school, with the exception of primary schools in towns with more than 15,000 inhabitants, where almost 1 percentage point more pupils were taught by distance learning in an average week than in municipalities with up to 2,500 inhabitants (see detailed results in Appendix 1).

Box 1: Reasons for blanket school closures by regional health officials

What were the health officials guided by when closing schools? Our analysis shows that the across-the-board closures in the district were not related to the severity of the epidemiological situation in the district, according to COVID Traffic Light system.[2] This suggests that other factors were considered by sanitation officials. To better understand them, we contacted 23 of the 36 RÚVZ. Of the 17 offices we received a response from, 6 were offices that closed across the board (1 office commented on the situation twice, as it closed one district across the board and the other was left open).[3] We had longer telephone interviews with 6 offices and communicated with the others by email.

Polarised public opinion may also have played a role in the hygienists' decision.

Hygienists who closed across the board most frequently mentioned[4] the critical situation of the health system in the district, e.g., lack of beds in hospitals in the region (5 out of 6) and also low vaccination rates among students and parents (5 out of 6). They also mentioned the high proportion of infected among younger age groups or the high morbidity of schoolchildren (4 out of 6) and the community spread of the virus (2 out of 6). One respondent described the decision to close as follows: "*The primary aim in this very bad situation was to reduce the number of new cases and thus relieve the health service by reducing pressure on hospital beds.*" Other respondents described the situation in hospitals as "alarming" or "critical" in the context of the decision to close. Only 2 out of 6 respondents said that they were not only guided by the local situation but also by the national situation when making decisions. According to one respondent, the situation was so serious that "*the relevance and meaning of a regional approach was declining*." Only one authority mentioned that it had taken into account the COVID Traffic Light ranking of the district in its assessment.

Of the offices that did not close across the board, the most common reason was a more favourable epidemiological situation in schools or in the district in general (7 out of 13), e.g. absence of community spread or a decrease in morbidity. Several health officials (6 out of 13) referred vaguely to the fact that they did not suspend classes because the rules in force at the time allowed it. Some (3 out of 13) stressed that they did not close across the board because the situation varied regionally, and others (2 out of 13) expressed concern about the negative effects of such a measure on pupils, e.g. their knowledge and social relationships. Thus, officials' attitudes towards the

[2] Most black districts remained open in December - 44 of 55 in the first week of the blanket closures, 36 of 54 in the second. In contrast, schools were closed across the board in districts in the less severe red and violet.

[3] Responses were received from either the Director(s) of the Authority or the Directors of the Epidemiology/Children and Youth Department.

[4] Several authorities made general comments, for example, that they were monitoring the epidemiological situation and the dynamics of the disease. In order to define (code) a factor as a reason for closure, the authority had to specifically name the value of the status of the indicator being monitored in the reply, e.g. that the vaccination rate was low, the morbidity rate high, the situation in the hospital poor.

importance of full-time education in schools may also have played a role in the closures. One authority stressed that school closures, whether across the board or selectively, did not have a sufficient legal basis and were therefore not considered, and another authority rejected 'precautionary' closures without the decision being backed up by data from the region.

Hygienists' decision-making was guided almost exclusively by the regional, not the national, situation. If the situation in a district was good, hygienists kept schools open, despite calls from the so-called consortium of experts and the chief hygienist to close schools across the board due to the poor national situation, regardless of the situation in the region (Čunderlíková, 2021; Gdovinová, 2021). Polarised public opinion may also have played a role in the decision-making of sanitary inspectors. It was clear from the interviews that regional authorities often faced hateful reactions from citizens. Some criticized them for closing schools, others for not closing schools. In addition, widespread closures may have been constrained by uncertainty about the legality of such actions on the part of some authorities.

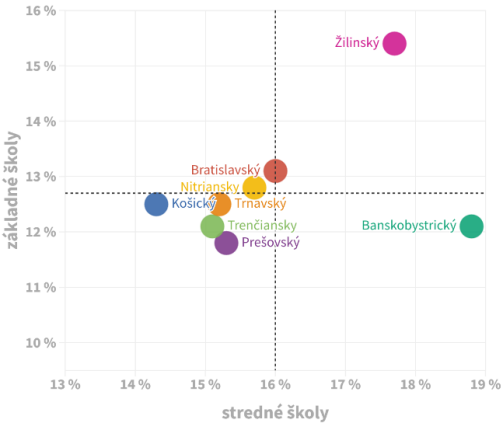
In some places, the pandemic had a low impact on primary schools but a high impact on secondary schools.

The inter-agency survey also showed that there were no common standards stating under what circumstances should schools be closed across the board, and health officials justified (non-)closures differently, using different indicators to which they assigned different weights. Decision-making was dynamic and meetings of regional crisis teams and input from regional stakeholders (schools, municipalities, hospitals) played an important role. The results showed that the best measure to avert widespread school closures was lower congestion in the health system and higher vaccination rates in the district.

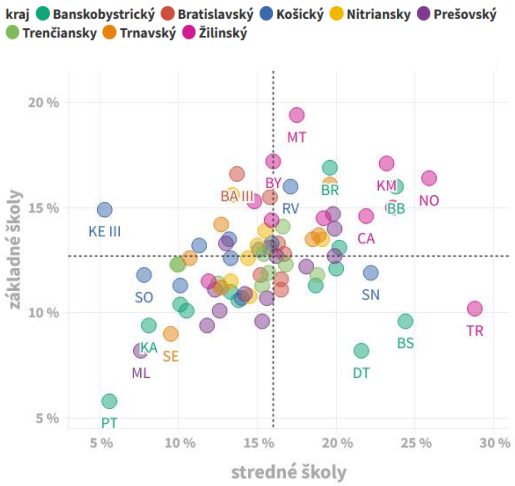
Some districts and counties were more affected by the pandemic than others. The Žilina region stands out, where both primary and secondary school pupils were home-schooled for a longer-than-average period of time (Figure 5). In the Banská Bystrica Region, the pandemic disrupted full-time classes in secondary schools the most among all regions. The impact of the COVID-19 pandemic on attendance often varied considerably not only within a single region but also within a single district. In some places the pandemic had a low impact on primary schools but a high impact on secondary schools (e.g. Detva). The overall impact on full-time education in the district also varied. In Poltár (PT), 6% of primary and secondary school pupils were not in full-time education in an average week, while in Námestovo (NO) it was several times higher - 16% of primary and 26% of secondary school pupils in an average week.

Chart 5: Average share of pupils in distance learning in the school year 2021/2022

5a. Regions



5b. Districts



Source: Education Policy Institute (2024), based on data from the Ministry of Education. The proportion of pupils in distance learning was calculated for the 24 weeks of the school year when data were collected on COVID-19 (September 2021 to March 2022). This includes pupils who were infected, quarantined, or distance-learning. The resulting number is the average of the weeks observed. The dashed lines indicate the national average. Y-axis = elementary schools, x-axis = high schools.

The impact of distance learning on school results depends on the subject

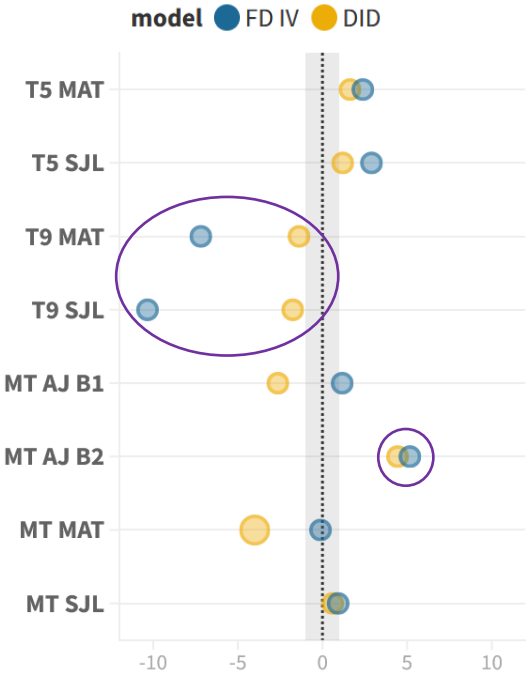
Since schools in Slovakia have switched to distance learning to varying degrees, we test the hypothesis whether distance learning (the average share of distance learning students per school) is associated with a school's performance (percentile) on standardized tests in the 2021/2022 school year - Testovanie 5 (T5) designed for elementary school fifth graders, Testovanie 9 (T9) for primary school ninth graders and, starting in 2019, for 8-year high school students, and the External Part of the Matriculation Examination (MT). After their implementation in the 2018/2019 school year, these tests, which are designed to test pupils' knowledge and skills according to the national curriculum, were administered after two-year-break again in the 2021/2022 school year.

We can only tell which schools did well in the tests, and which did poorly compared to other schools or the average for that year.

This analysis does not speak to whether students' knowledge worsened during the pandemic. The nature of the standardised tests administered in Slovakia does not allow us to compare the level of pupils' knowledge over time.[5] For example, compared to the PISA tests, we cannot tell how many pupils in a given year achieved a high level of reading literacy. We can only tell which schools did well and which did poorly in the tests compared to other schools or to the average in a given year. Thus, this analysis tells us about the impact of distance learning on schools' placement in testing. We test the hypothesis using two statistical models, difference-in-differences (DID) and first-differences using an instrumental variable (FD IV). We describe the methodology in Box 1.

Longer distance learning does not have a clear negative impact on school performance across tests. Of the 8 tests we analyzed using 16 models (16 balls in Figure 6), longer distance learning at school has a *positive* impact on school percentile on four tests (T5 MAT, T5 SJL, MT AJ B2, MT SJL)[6], *a negative impact* on three (T9 MAT, T9 SJL, MT MAT), and an ambiguous impact on one (MT AJ B1). In the last case, it is a situation where one model evaluated the impact as positive and the other as negative. Moreover, some models show relatively low impacts approaching zero.

Figure 6: Impact of a 10 percentage point increase in the average share of distance learning students on a school's test percentile



Source: Education Policy Institute (2024). The chart shows the estimated change in a school's percentile for a change in the average proportion of pupils educated at a distance (see Box 1). DID = difference-in-difference. FD IV = first difference model with instrumental variable. Larger circles mean that the result is statistically significant at the 95% level. The grey box indicates the (arbitrary) threshold from -1 to +1.

Distance learning has the most significant negative impact on Testovanie 9. In this case, the impacts are consistent and high. Depending on the model, an increase of 10 percentile points in the average share of distance learning pupils is associated with a deterioration of 1.4-7.2 (percentile) points in Mathematics and 1.8-10.3 points in Slovak, depending on the model, in the school's percentile score. These conclusions hold even after accounting for changes in the structure and characteristics of the pupils tested, which may also influence the change in a school's percentile over time. We also tested the robustness of the results with alternative models (see Appendix 2).

[5] The introduction of a new type of tests (so-called criterion-referenced) is planned from 2025/2026 for pupils in Grade 3 of primary school (completion of Cycle I) in a sample of schools implementing the new national curriculum. Subsequently, they will be implemented annually on a representative sample of schools in succession after the end of cycle II (Grade 5) and in Grade 8.

[6] MAT = mathematics, SJL = Slovak language (and literature), AJ = English language, B1 = easier level, usually written by secondary school graduates, B2 = harder level, usually written by secondary school graduates.

Grammar schools were more resilient to the negative impact on T9 than elementary schools. Neither in the case of Slovak nor in the case of Mathematics do we observe a clear negative significant impact of longer distance learning. In contrast, for primary schools, the negative impacts of distance learning are even worse (-11.8 points for Slovak, and -8.3 points for Mathematics). [7]

In the case of the English, the impact of distance learning varies according to language level. At the easier level (B1), the impact is ambiguous, while at the harder level (B2) the impact is clearly positive at 4.4-5.2 points. Research from abroad does not help us to interpret these results because it has rarely looked at the impact of pandemics on pupils' knowledge in foreign languages.[8] The positive impacts may be related to the fact that higher language proficiency is associated with a higher ability to learn a language independently. In addition, school closures and limiting 'offline life' have been associated with an increase in time spent online (Zhdonov et al., 2022; Medrano et al., 2020). There, high-schoolers were able to interact with English more frequently, benefiting especially those who had a better command of the language. Positive influences in the case of foreign languages are also mentioned in research among Slovak teachers (Vorlíček, 2023, p. 10): '*However, among teachers, especially those who teach foreign languages, there were also opinions that some children improved because they spent more time on the Internet, watching movies and some children improved their knowledge of foreign (especially English) language*.' In any case, the impact of the pandemic on foreign language skills deserves more attention.

Box 2: Methodology for calculating the impact of distance learning

Although standardised tests measure very similar areas of knowledge and school performance correlates strongly from year to year, the form, content and difficulty of the tests varies in time. These tests assess a pupil's relative performance compared to other pupils and absolute test results cannot be compared. Because of this, we analyze the change in the percentile, the relative performance of a school over time, which tells us whether the school has improved or deteriorated relative to others. The key explanatory variable is the **proportion of pupils in distance learning**, which we measured by calculating for each school and each of the 24 weeks of the school year under study (September 2021 to March 2022), the percentage of pupils in distance learning (including infected and quarantined pupils) in an average week. The average for all primary schools was 12.6% and for secondary schools was 16.0%.

Pupils, teachers and parents have also been able to adapt to distance learning over time

Since the rate of distance learning at a school was not random, e.g., depended on the size of the school, we use methods that can account for the "non-randomness." The first is a **difference-in-differences (DID**) model, which we use to analyze testing from 2016 to 2022. It is a quasi-experimental method used to assess the effect of an intervention (distance learning) on a dependent variable (school percentile). The assumption of the method is that both groups would follow a similar trend in the dependent variable over time in the absence of the intervention. We successfully tested this assumption (see Appendix 4). By default, this method is used by comparing the group that received the intervention (intervention group) with the group that did not receive the intervention (control group). In our case, this research design would have been too simplistic as the schools were closed for different lengths of time. Therefore, we use distance learning as a continuous intervention of varying intensity/dose (see Callaway et al., 2024). The results of the model can be interpreted as the causal effect of longer distance learning and we interpret them similarly to the OLS regression, i.e., ceteris paribus, the coefficient (average treatment effect on the treated, ATET) tells us the *average change in* a school's percentile as the proportion of students in distance learning increases by 1 percentage point.

The second model is the **first difference model using an instrumental variable (FD IV).** The method calculates the difference in all school characteristics in 2022 compared to 2019 (we do not consider other years). In this way, we also account for unobserved school characteristics that are fixed over time

[7] In this case, we rely only on the results of the FD IV model, since DID works with a longer time period during which T9 was not yet written in 8-year high schools.

[8] Two studies from China found negative impacts on English outcomes (Clark et al., 2020; Feng et al., 2021), while a study from the Netherlands found no impact on French outcomes (van der Velde et al., 2021).

and are omitted in the method (e.g., school type, location, prestige). To account for non-randomness, we use an instrumental variable - the number of weeks the school was closed across the board by the RÚVZ, which is correlated with the independent variable (average weekly share of pupils in distance learning), and which we assume has no direct effect on the dependent variable other than through the independent variable. The coefficients are interpreted in the same way as in the OLS linear regression.

School outcomes can change over time for a large number of reasons, so we use a rich set of **control variables**: the proportion of those tested in the subject with a disability, from a socially disadvantaged background (SZP), girls, foreigners, with a parent with at most a primary school education, with a parent with a university degree, the number of those tested in the school in the subject. For elementary schools, we also consider whether the school participated in the "Spolu múdrejší" 1, 2, 3 tutoring programs and the summer schools in the summer of 2021, which aimed to mitigate the knowledge gap caused by the pandemic. The control variables in both models are the same. We cluster standard errors at the municipality level.

We work with individual data from various departmental databases on almost 1.2 million tested students as of 2016, or approximately 1,500 elementary schools and 700 high schools. Data on test scores are from the National Institute of Education and Youth (NIVAM), on blanket closures from the website ucimenadialsku.sk[9] on parents' education and material need from the Institute of Financial Policy (IFP), and on summer schools and tutoring from the Ministry of Education website. In the results we do not comment on the effects in terms of their statistical significance, as this is not a fundamentally important characteristic in research on the whole population (Figueiredo Filho et. al, 2013). To be more confident of the results, we run several alternative models as robustness tests (Appendix 2).

At the easier level (B1), the impact is ambiguous, while at the harder level (B2) the impact is clearly positive

The negative impact of distance learning is more noticeable in mathematics than in Slovak. In the results we see a negative impact on 2 out of 3 mathematics tests (T9, MT), while in the case of Slovak it is positive on 2 out of 3 tests (T5, MT). These results are consistent with foreign meta-analyses that agree that students' knowledge suffered more in math than in reading during the pandemic (Betthäuser et al., 2023; Di Pietro, 2023; Patrinos et al., 2022). Di Pietro (2023, pp. 4-5) gives three reasons why: (1) the pandemic required parents to be more involved in homeschooling, and in the case of mathematics, parents were not able to help their children as much as in reading; (2) teaching mathematics online is more challenging; and (3) the economic and health problems caused by COVID-19, combined with the sudden transition to online learning, likely increased students' anxiety about mathematics. Moreover, in the case of reading, students also improve their skills when they read for pleasure outside of school (Betthäuser et al. 2023, p. 380). Thus, progress in reading is not as tied to traditional face-to-face instruction as progress in mathematics.

Why doesn't longer distance learning have a clear negative impact on all subjects? We assume that schools were able to substitute distance learning for face-to-face education of comparable quality in most subjects, and therefore their ranking relative to other schools in the test did not change significantly. The fact that distance learning was not substantially long in the 2021/2022 school year may also play a role. Schools were open for most of the school year. Depending on the district, students spent between 1 and 3 weeks being educated from home due to the across-the-board closures; otherwise, classes and schools were only closed on an individual basis depending on the situation at the school. Additionally, students, teachers, and parents were also able to adapt to distance learning as time went on (Vorlíček, 2023, p. 7). Adaptation to the pandemic also explains why, abroad, the effects of school closures on pupils' knowledge were more negative in the first wave of closures than in subsequent ones (König & Frey, 2022).

Why does the negative impact on primary school performance vary by age and is only observed for ninth graders? It is possible that for younger children (fifth graders in elementary school), parents compensated for the loss of attendance and knowledge to a greater extent. At the same time, fifth

[9] https://ucimenadialku.sk/usmernenia/obmedzenia-prezencnej-vyucby

graders writing T5 in 2022 are highly likely[10] to have spent less time in distance learning than ninth graders. The first grade of elementary school, which they attended as fourth graders, closed less frequently than second grade and high schools in the previous school year. For ninth graders, parents' ability to help with instruction is also lower due to the higher complexity of the curriculum. In addition, parents are more likely to expect higher levels of independent learning for ninth graders than for fifth graders. It is also possible that replacing face-to-face instruction for ninth graders with online instruction was more difficult than for elementary school fifth graders and high school seniors for reasons that are unclear.

The weakness of the data presented is that we do not account for the possible cumulative effect of distance learning at the school from the previous school year (2020/2021), and that we only have distance learning data at the school level and not at the grade level of test takers or students. At the same time, many schools did not send data with sufficient quality and frequency. A change in the type of standardised testing conducted in Slovakia and more consistent recording of distance learning would allow us to assess the impacts of the pandemic more accurately in the future.

Pupils with weaker socio-economic backgrounds are falling further and further behind

The impact of the pandemic on pupils' knowledge may have been selective. In particular, in some countries, the performance of pupils from lower socioeconomic backgrounds deteriorated more during the pandemic (Betthäuser et al., 2023). Therefore, the pandemic may have led to widening inequalities. In the following section, we use descriptive analysis (we do not use statistical models) to describe how pupils' scores on standardized tests evolve over time, and whether we observe significant changes in the observed trends after the pandemic. We analyze the evolution of the performance of different groups of students on standardized testing by (1) parental education, (2) gender, (3) and we also test whether the gap between students from socially disadvantaged backgrounds (SEN)[11] and the rest of the population has widened, (4) and whether the best students (top 20% performers) have moved away from the worst students (bottom 20%). Again, to ensure comparability of the tests over time, we do not observe the achievement of these groups on the tests, but the relative achievement - the ratio of the average achievement of one group to the average achievement of the other group.[12] It is important to emphasize that the graphs show only correlational evidence and differences in the performance of groups over time may be influenced by other factors. Detailed results are included in the data appendix.

As expected, we observe significant differences in test scores among the selected groups of students even before the pandemic. For example, the worst performing pupils on T9 in English scored only about a third of the results of the best performing pupils. We also observe high disparities by parental education. Pupils with parents who have completed at most primary school achieve on average less than half the results of pupils with at least one parent with a university degree on T5 in Slovak. Pupils from socially disadvantaged backgrounds generally lag behind other pupils. The smallest differences in performance are between the sexes - in mathematics the results are equal, with girls performing slightly better in Slovak and slightly worse in English.

The smallest differences in achievement are between genders - in mathematics the results are equal, in Slovak girls perform slightly better, in Mathematics slightly worse

[10] For example, the government closed all schools except for kindergarten and the first grade of primary schools on 26 October 2020 (Ostertágová & Rehúš, 2021, p. 2). However, at the same time, detailed data collection did not work in this school year, as it did in the 2021/2022 school year.

[11] In this category we count pupils from the SEN according to § 2 písm. p) zákona č. 245/2008 Z. z. as well as all beneficiaries of material deprivation in the 3 years prior to testing (so that pupils who fall just above the threshold over time do not drop out of the beneficiaries).

[12] We arrived at similar results by comparing the differences (not the ratio) in the average success rate and the differences in the average percentile.

In 2022, the average achievement of pupils from socially disadvantaged backgrounds relative to other pupils was at its lowest level since 2016 in 7 out of 8 tests. In 2016, the average performance of pupils from SEN at T9 in mathematics was 63% of that of other pupils, but in 2022 it is only 46%. On the T9 in Slovak, they even reached 75% in 2016, compared to 59% in 2022. We see similar trends on the matriculation exams, except for English at B1 level. In the Slovak test, we see for the first-time pupils from the SEN[13] achieving less than 80% of the results of other high-schoolers. Pupils with parents with lower educational attainment also fell behind in most tests. In 5 out of 8 tests we see this group of pupils achieving their lowest results since 2016 (T5 MAT, T9 MAT, T9 SJL, MT AJ B1, MT SJL). For example, ninth graders whose parents have completed no more than primary school scored roughly 45% of the average score of students with at least one college-educated parent on T9 math in 2016. In 2022, it was only 35%.

Differences in pupil performance by socio-economic background (CSR and parental education) have been increasing since 2016.

The trend of widening educational inequalities is worrying, but it is not necessarily just the impact of a pandemic. In several tests, we see that disparities have been changing in the past, or that inequalities have been deepening since 2016, the period before the pandemic. The post-pandemic drop in performance may be confirmation of a pre-existing trend of widening disparities. On the other hand, there are several reasons why the poorer performance of students with weaker socioeconomic backgrounds can be attributed to the pandemic. As Betthäuser et al. (2023) write, these pupils are "also *likely to be disadvantaged in terms of their access to and ability to use digital learning technologies, the quality of their home learning environment, the learning support they receive from teachers and parents, and their ability to learn independently*." Surveys from Slovakia confirm these explanations. In the 2019/2020 school year, pupils from schools with a high proportion of pupils from socially disadvantaged backgrounds were more often not participating in distance learning (Ostertágová & Čokyna, 2020).

Even if compensatory measures have helped, they have failed to reverse the trend of widening inequalities.

Chart 7a: Educational inequalities of fifth and ninth graders

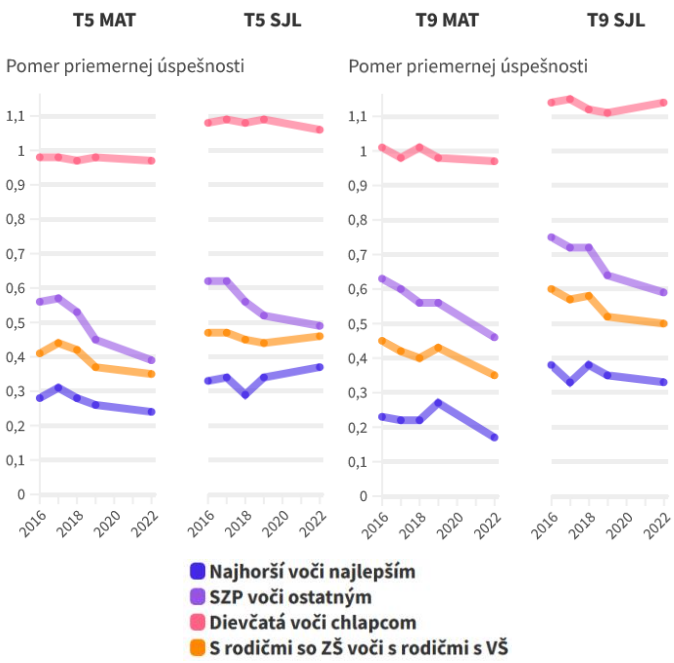
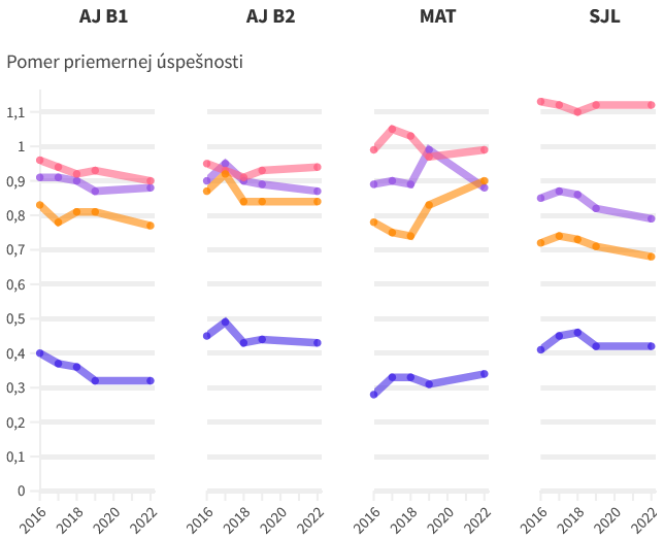


Chart 7b: Educational inequalities of school leavers



Source: Education Policy Institute (2024). The graphs show what percentage of the average results of the second group (e.g. parents with HE) are achieved by the first group (e.g. parents with primary school). A ratio of 1 means that the first group achieves 100% of the second group's results. Blue = worst performers/best performers, violet = SEN/others, red = girls/boys, orange = children of parents with elementary school education/college degree.

[13] Few pupils from socially disadvantaged backgrounds graduate from high school. For example, in 2022, in the case of Slovak tests, pupils from SEN accounted for 10.3% of those tested, 7.5% in T9 and only 2% at the matriculation testing. The lower proportion of pupils from SEN among matriculants may also explain higher volatility of observed differences.

On the other hand, the gaps between the best and worst performers remained similar in most subjects, as did the gaps between boys and girls. The exception is T9 in mathematics, where the worst pupils lagged significantly behind the best. In 2022, only the worst performs achieved only 17 % of the average results of top performers, whereas in the past the figure stood between 22 and 27%. Moreover, the widening of the gap to the highest level since 2016 is also observed in all districts in this case.

We observe widening educational inequalities despite the implementation of several compensatory measures to mitigate the impact of the pandemic. For example, the Department of Education has supported the implementation of 3 tutoring projects through (Spolu múdrejší) between April 2021 and June 2022, and 3 years of summer schools have been implemented in 2020, 2021 and 2022. We are unable to evaluate the effectiveness of these measures based on the available data. Even if the compensatory measures have helped, they have failed to reverse the trend of widening inequalities. This may be because a large proportion of schools have not implemented any of these projects. Only 37% of primary schools and 14% of special primary schools have implemented at least one tutoring project. Only 22% of primary schools and 8% of special primary schools implemented summer schools in 2021. This participation rate is quite low considering that in a survey of second cycle primary school teachers, 61% stated that their school should organise tutoring sessions when they return to school and even as many as 78% declared their willingness to personally tutor (Ostertágová & Rehúš, 2021).

Recommendations

Based on the results of the commentary and familiarity with the conclusions of foreign research, we formulate the following recommendations to mitigate the impacts of the COVID-19 pandemic, to better understand them in areas not addressed in this commentary, and to take steps that would improve future crisis management and minimize the negative impacts of crisis situations on Slovak education. We recommend:

1. **Promote measures that will lead to greater equity in pupils' educational outcomes.** There is a need to address and reverse the trend of growing underachievement of pupils from socially disadvantaged backgrounds that we have identified. Examples include the continued support for tutoring or summer schools.
2. **Supporting teachers' digital skills and digital provision in schools.** This can be an important tool to mitigate the impact of crises leading to restrictions on face-to-face education (e.g. pandemics, extreme weather). As one study looking at the impact of COVID-19 on pupils' knowledge notes, "*Countries with advanced levels of digitisation and more intensive use of ICT in education before the pandemic were less affected*." (De Witte & François, 2023). Also, a survey of Slovak teachers suggests that the transition to distance learning was better in schools with good digital equipment and digital skills of teachers (Vorlíček, 2023, p. 7). Investing in digital infrastructure in schools is one of the priorities in the Recovery and Resilience Plan of Slovakia.[14]
3. **Promoting pupils' access to distance learning**. The pandemic has highlighted that pupils' access to online learning is not the same. Without the provision of digital facilities and internet access on the part of pupils, closing schools and moving to online learning is a restriction on the right to education (see Korzár, 2023)
4. **State institutions should consider issuing methodological guidance on the blanket closure of schools.** Our survey of regional health inspectors showed that they were not following common standards, and some were unsure about the legality of blanket closures. Such guidance could lead to more predictable and transparent decision-making on school closures in the future. Moreover, if the national situation calls for nationwide school closures,

[14] https://www.minedu.sk/data/att/92b/28254.21abdf.pdf

the state must take such a decision itself, not delegate it to regional health officials. They will approach school closures conservatively and according to the local situation.

5. **In the event of a pandemic outbreak (or other crisis leading to school closures), data collection on the transition to distance learning should be implemented immediately and information on potential impacts should be collected on an ongoing basis.** Data is needed on which schools and classes are closing and for what reasons, which would help to identify schools with a greater need for compensatory measures on an ongoing basis. We were only able to analyze distance learning rates for one school year in this commentary due to the unavailability of data on school closures. Moreover, the introduction of policies and measures should be accompanied by a priori considerations of the data needed for their ex post evaluation. However, only data necessary for pandemic monitoring should be collected to avoid administrative burden on schools and to ensure privacy.
6. **Establish regular data collection on pupil and teacher attitudes, needs and satisfaction.** In Slovakia, important indicators about the Slovak education system are not systematically and regularly measured, which limited this research. One-off surveys and questionnaires offer only fragmentary information on the state of education and limited scope for analysing the impact of reforms. One possibility is a regular survey that would allow systematic monitoring of the state of Slovak education. Good practices can be found in Estonia, which since 2018 offers schools the opportunity to have their pupils take part in a survey every year, and every three years teachers and parents also fill in the questionnaire. In 2019, up to 92% of general education schools participated in the pupil survey.[15] This data allows the Estonian authorities to monitor the development of teacher and pupil satisfaction. The increase in satisfaction is one of the strategic goals and a measurable indicator for the Estonian education system until 2035.[16]
7. **We need further and more comprehensive research on the impact of COVID-19 on Slovak education**. The task is to identify which actions regarding the management of education during the pandemic were right, which were wrong, and to formulate recommendations for the successful management of similar crisis situations in the future. It is all the more important to gather lessons learned when Slovak teachers rated the Ministry's support critically in several surveys (Vorlíček, 2023; Ostertágová & Rehúš, 2021). These surveys name several key topics that deserve more attention: mental health of pupils and teachers, attractiveness of the teaching profession, social relations and pupils' behaviour, attendance, truancy, dropout, grading, etc. We also need to further investigate the effectiveness of online English teaching. Our findings show clear positive effects of longer distance learning on the average performance of school leavers in the English matriculation testing at B2 level. The results of further research could have important implications regarding the way English is taught. We also need to find out what the schools and teachers whose students did not experience a decline in performance during the pandemic have in common, including why, in the case of T9, we register such a significant difference between the impact of distance learning on primary schools compared to grammar schools.

[15] https://www.educationestonia.org/innovation/assessment/.
[16] https://www.educationestonia.org/wp-content/uploads/2022/12/haridusvaldkonna_arengukava_2035_kinnittaud_vv_eng_0-1.pdf

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Appendix

Appendix 1: Imputation

Not every school sent data on the number of distance learning pupils with sufficient quality and frequency. If a school sent data for at least half of the 24 weeks analyzed, we imputed data for the missing weeks using multivariate imputation with chained equations (Van Buuren & Groothuis-Oudshoorn, 2011) using the following variables: the proportion of pupils in distance learning in the previous week, the next week, and the average proportion of pupils in distance learning in the district in schools of the same type, and the number of pupils in the school. In this way, we imputed 6.2% of all data at the week level. For other schools, we imputed the data for the entire period using the same method. In this way we imputed data for 863 schools (29.1%) out of a total of 2 964 schools attended by 154 thousand pupils (22.8%) out of a total of 675 thousand pupils. We imputed the data using the following variables: the average proportion of pupils in distance learning in schools of the same type in the same municipality or district; the number of weeks of area closure in the district; the size and founder of the school; the November 2021 district-level dose 1 vaccination rate; the district and municipality size.

Appendix 2: Variability in the length of distance learning

We model the proportion of pupils not in full-time education in an average week due to COVID-19 between September 2021 and March 2022 as ranging from 0 to 100 (%). We use multi-level modelling with 3 levels - schools are 'nested' within villages and villages are nested within districts. This method, compared to standard models, helps to avoid bias caused by the similarity of observations to each other in hierarchical data. However, similar results to those presented in the table were also obtained using linear regression and fractional logit regression. We do not find that pandemic situation as measured by the COVID Traffic Light (the number of weeks when the district was in the worst black colour) is related to the rate of distance learning at the school. However, longer distance learning is associated with higher number of days of blanket closures, which has a significant effect in both models. Primary schools with only second level (Grades 5 to 9, 36 schools) were also closed for longer, with up to 3.5 percentage points more pupils being educated in an average week. This may be a consequence of the fact that the first level of primary schools (Grades 1 to 4) was never closed across the board during the period under review.

Table 1: Characteristics associated with longer term attendance restrictions at school

Explanatory factors	Primary schools			Secondary schools		
	Coefficient	SE	p	Coefficient	SE	p
Number of pupils	0,003	0,001	0,000	0,003	0,001	0,001
Percentage of pupils from disadvantaged backgrounds	-0,013	0,005	0,008	-0,039	0,014	0,004
Number of weeks in black (COVID Traffic Light)	-0,006	0,043	0,895	0,113	0,158	0,477
Number of days of blanket closure (0 to 15)	0,280	0,068	0,000	0,722	0,196	0,001
Black colour*Blanket closure (interaction)	0,003	0,004	0,38	-0,003	0,017	0,852
Municipalities with 2 500-7 500 inhabitants (vs. up to 2 500)	-0,260	0,349	0,456	-0,304	1,019	0,766
Municipalities with 7 500 to 15 000 inhabitants (vs. up to 2 500)	-0,300	0,609	0,622	0,307	1,074	0,775
Municipalities with 15 000+ inhabitants (vs. up to 2 500)	0,876	0,449	0,052	-0,187	0,987	0,850
Private school (vs state school)	-0,936	0,426	0,028	-0,142	0,585	0,808
Church (vs state)	-0,843	0,552	0,127	0,209	0,469	0,656

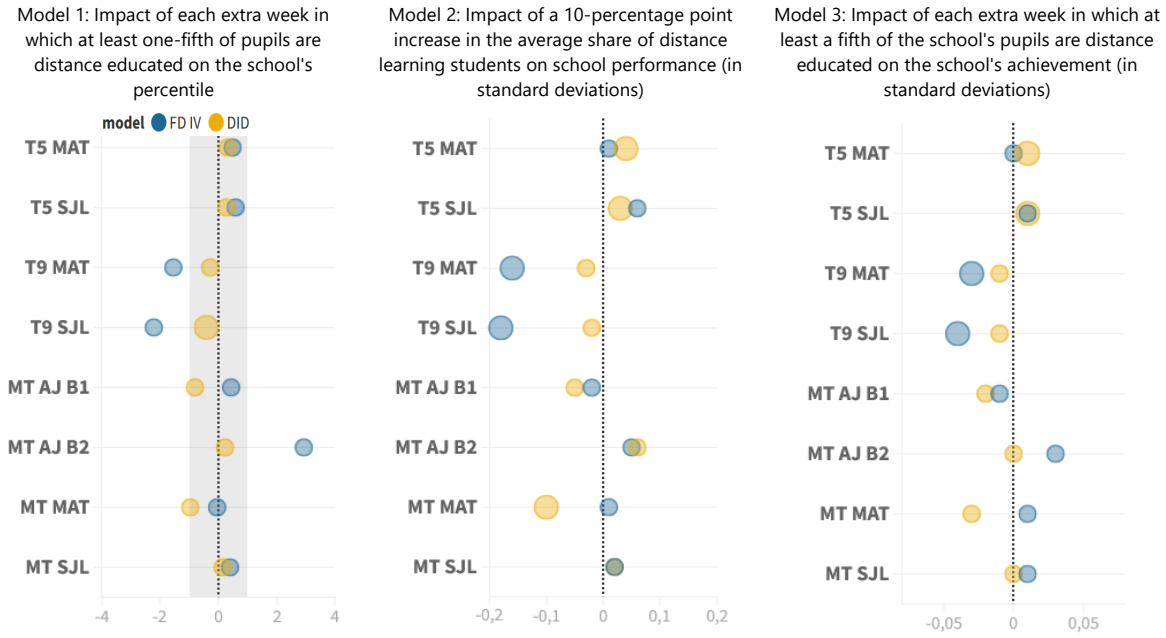
Primary school with only 1st level (vs primary school with two)	-0,660	0,496	0,183			
Primary school with only 2nd level (vs primary school with two)	3,542	0,772	0,000			
Secondary school (vs grammar school)				0,282	0,683	0,680
Other secondary (vs grammar school)				-0,414	0,385	0,283
Number of observations	*2 184*			*780*		

Source: Education Policy Institute (2024) based on data from the Department of Education, Institute for Health Analysis (2022), Census (2021). Results of multilevel linear regression models. SE = standard error. Red indicates statistically significant values (p < 0.05).

Appendix 3: Alternative ways of calculating the impact of distance learning

To test the robustness of the impact of distance learning on school outcomes, we also estimated alternative models that use a different operationalization of both the dependent variable (percentile) and the independent variable (average weekly share of students in distance learning). First, we changed the calculation of the independent variable from the proportion of pupils to the *number of weeks when at least 20% of the school's pupils were distance educated (Model 1)*. We also tried an alternative way of modelling the dependent variable, and instead of percentiles, we modelled the average achievement of the school's pupils in standard deviations from the mean, both in combination with the original independent variable (Model 2) and with the new independent variable (Model 3). In all models, we find similar results, that is, the most consistent negative impacts for both tests are for T9 and positive impacts for AJ B2 matriculation.

Figure 8: Alternative calculations of the impact of distance learning on school performance



Source: Education Policy Institute (2024). Larger circles mean that the result is statistically significant at the 95 percent level. 1 standard deviation (SD) generally ranges from 15 to 25 percentage points, depending on the year and the test.

Appendix 4: Comparison of DID by type of intervention

The basic assumption of the difference-in-differences (DID) model is that without the intervention, the control and test groups would follow the same trend. We created a simplified model where we treat the intervention as binary (treated/not treated). We divided the schools into two groups - the control group contained schools that had a below-average proportion of students in distance learning (not treated) and a treatment group which contained schools with an above-average proportion, i.e. those that were more affected by distance learning. We tested the parallel trends assumption using the estat ptrends function in Stata. This function performs a test whether the linear trends of the dependent variable between the control and test groups during the period before receiving the intervention are parallel. The null hypothesis is that the linear trends are parallel, and thus the nonsignificant values (p > 0.05) are confirmation of this assumption. In the table below, in the last column, we see that parallel trends

cannot be ruled out in any of the models tested. In the table we also compare how the results of the model (ATET) with the binary intervention differ from the results of the model using the so-called continuous intervention.

Table 2: Differences in the impact of distance learning and test for parallel trends

	ATET		SIGNIFICANCE		
testing	**Binary**	**Continuous*10**	**Binary**	**Continuous**	**Parallel trends**
T5 SJL	0,50	1,19	0,61	0,23	0,37
T5 MAT	0,01	1,62	0,99	0,05	0,14
T9 SJL	-2,91	-1,76	0,01	0,10	0,89
T9 MAT	-2,19	-1,39	0,03	0,14	0,78
MT SJL	0,59	0,60	0,59	0,59	0,69
MT MAT	-4,92	-4,01	0,03	0,04	0,15
MT AJ B1	-2,03	-2,64	0,42	0,31	0,12
MT AJ B2	2,04	4,43	0,44	0,07	0,81

Source: Education Policy Institute (2024). Red indicates statistically significant values (p < 0.05). The continuous*10 column represents ATET every 10 percentage points of students in distance learning at the school (as in Figure 6).

Data Appendix

Includes data for each chart.