ZEW Expert Brief

NO.20-13 // 5 OCTOBER 2020

// Maximilian Bach (ZEW Mannheim), Guido Neidhöfer (ZEW Mannheim),
Sarah McNamara (ZEW Mannheim) and Friedhelm Pfeiffer (ZEW Mannheim)

Rethinking Schooling

On the effects of school closures on the competence development of primary school children and the need for equality in education provision

Leibniz Association

ZEW

Executive Summary

- School closures are one of the measures taken to combat COVID-19. By restricting social contact, closures contribute to the containment of infection chains. However, such measures have side effects that directly affect learners, since the loss of instruction time may lead to a reduction in learning outcomes.
- Our empirical analysis for primary school aged children shows that school closures could exacerbate inequalities relating to a child's family-background.
- Some schools, and particularly dedicated teachers, are trying to provide alternatives to traditional classroom-based learning via online offerings and digital classroom instruction. However, it is precisely in these cases that non-school-related factors, such as the family environment, may become increasingly important once again and reinforce existing inequalities.
- School closures thus jeopardise the claim of equality in education made by education policymakers, particularly during the early years of primary school. It is therefore imperative to rethink the current approach to schooling.
- In light of digital progress, for the first time there exists the potential to bring professionalised, pedagogically tested interactions into the everyday life of school children while outside of the classroom environment. Rethinking schooling means doing justice to the need for equality even in times of school closures. This will be possible if age-appropriate high-quality instruction no longer needs to be tied to the school as a physical location.

1. Introduction

One of the first measures taken worldwide to contain the COVID-19 pandemic was to close schools at the regional or national level. Over the course of the pandemic, schools were closed in 194 countries around the world, and in most cases they remained closed for several months. In Germany, schools were closed nationwide on 18 March, 2020, with regional school closures having already taken place on 3 March. According to UNESCO estimates (2020), more than 1.5 billion learners worldwide have been affected by these closures.

2. The Inequality of School Learning Outcomes as a Challenge for Education Policy

School closures are only one element of the measures taken to combat the pandemic (see below). By restricting social contact in and around schools, such measures help to contain the spread of COVID-19 (e.g. Dehniger, 2020; Neidhöfer and Neidhöfer, 2020). At the same time, school closures appear to be associated with relatively low short-term costs compared to the imposition of curfews and economic shut-downs (e.g. Adda, 2016).

However, school closures have significant side effects, particularly those with a lengthier duration. One group of side-effects results from the fact that parents must look after their children themselves during the period in which schools are closed. This is especially true for individuals with younger children that have no alternative childcare options. In order to keep the subsequent loss of working hours to a minimum, throughout the ongoing COVID-19 crisis some schools offered childcare to those students whose parents or guardians would otherwise be unable to work, for example those employed in the health care sector. A second group of side effects, which directly affects learners, is the loss of in-classroom teaching as a result of school closures, which may lead to a decline in academic achievement among students. In the following, this second group of side effects will be examined in greater detail in the primary school setting.

Pedagogical research suggests that academic learning outcomes are shaped by non-school-related factors, particularly the socio-emotional and economic family environment. Inequality of learning outcomes may once again increase when compared to traditional face-to-face teaching, as our analysis in this expert brief suggests. In the case of school closures, some schools and particularly dedicated teachers are attempting to provide learning alternatives by offering online and digital classes. However, these attempts would need to be very far-reaching in order to sufficiently compensate for the influence of the family environment, which is more likely to affect learning than when children are participating in traditional classroom-based learning. Although schools in Germany have already reopened, strict social distancing and hygiene rules mean that day-to-day school life will continue to differ for some time compared to the pre-closure environment, and further school closures cannot be ruled out.

This means that schools around the world are facing two major and interrelated challenges. The first challenge is to systematically expand digital teaching methods in order to provide professionalised alternatives to face-to-face teaching. In a transitional phase, this will likely require schools to focus more heavily on content that is essential from a pedagogical perspective, in order to give both teachers and students time to adjust to the organisational and technical changes. The second challenge is to ensure that the schools' mission of providing equal educational opportunities for all learners is fulfilled as far

as possible, even in times of school closure. The following analyses illustrate the extent of these challenges, and contribute to an evidence-based foundation for education policy-making.

Why were schools closed during the COVID-19 pandemic?

Studies have shown that school closures during influenza outbreaks and other diseases can be an effective containment measure, reducing the rate of reproduction and limiting the resulting negative health outcomes (e.g. Litvinova et al., 2019). For this reason, school closures were one of the first measures adopted by most countries for containing the spread of COVID-19. Although children and adolescents are less likely to contract COVID-19, and experience milder disease courses, their role in the spread of the virus is not yet fully understood (see e.g. Baggio et al., 2020; Heald-Sargent et al., 2020; Levinson, 2020; Ludvigsson, 2020).

However, school closures are not only an effective means of maintaining social distance between children. Many parents affected by the closures are not able to be physically present at work due to their childcare responsibilities, which also contributes to a reduction in the risk of infection. Furthermore, the decision to close schools sends a signal that has an effect on the population's understanding of the seriousness of the situation.

3. An Empirical Estimation of the Differential Learning Costs

The aim of this empirical analysis is to estimate the impact of the COVID-19-related school closures on the learning outcomes of children with respect to their family environment. Based on nationwide representative data, we estimate the learning deficits via two potential channels. On the one hand, we estimate how much knowledge is imparted in regular schooling per month. On the other hand, we investigate how the development of different competences differs according to family background when students are not in school. Furthermore, we identify possible learning opportunities in the family environment, particularly with regard to digital learning, from which recommendations for education policy interventions can be derived.

Learning outcomes in primary school and during the summer break

During primary school, important foundations are laid for a successful school career. We estimate the monthly learning gain in the basic competences, i.e. mathematics and reading, separately for the 1st, 2nd and 4th grades. We also examine differences in the development of these competences during the summer break between the end of 1st grade and the beginning of 2nd grade. Furthermore, we evaluate teachers' assessments of students' mathematical and written language skills, as well as their perseverance and ability to concentrate. The data is from starting cohort 2 of the National Education Panel (NEPS, see Blossfeld et al., 2011). This is a nationwide representative survey of children conducted at regular intervals since they entered primary school at the beginning of the 2012/13 academic year.

Previous studies have already estimated the average increase in learning outcomes over the course of a full school year (e.g. Wendt et al., 2017). However, these studies likely overestimate the extent to which learning gains can be attributed to the school. Particularly for primary school-age children, learning ability increases very dynamically with age and therefore some of the learning gains throughout the

school year may be attributed to age effects. In order to estimate school-related learning gains, we exploit differences in testing dates between schools. For example, some schools tested their students' competences in November, while other schools did not test them until January. If we compare the test results from different testing periods, and abstract from the age effect, we can estimate the schooling-related learning gains. This method allows us to control for the age effect by means of regression analysis, since students of different ages were tested on each of the testing dates. Since the start-date for the school year, and thus the months spent at school, can vary from state to state due to the length of the summer break, we only compare students from the same state.

The socio-economic family environment

The socio-economic family environment (SES) is measured using an index that captures both the educational background and occupational prestige of the parents (see Figure 1).

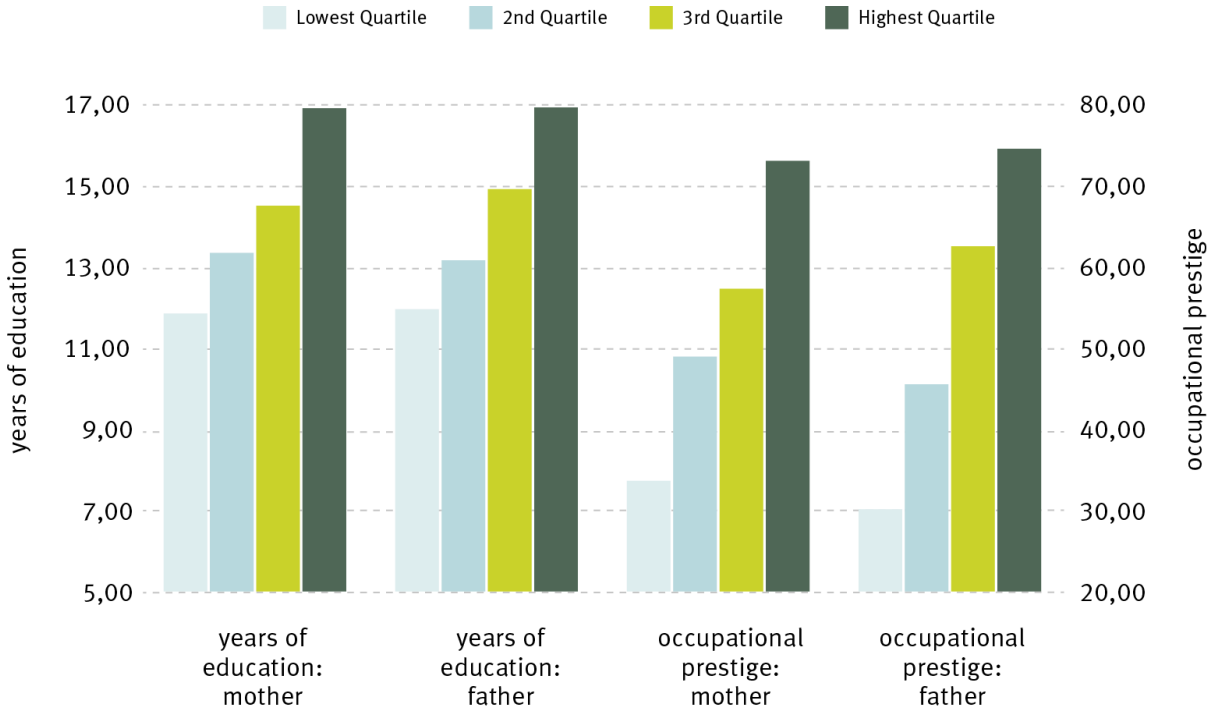

Figure 1

Years of education vary on a scale from 9 (which in many states corresponds to a lower secondary school leaving certificate) to 18 (university degree). Occupational prestige is measured using the ISEI (International Socioeconomic Index of Occupational Status; Ganzeboom et al., 1992). The lowest value of the ISEI is 16 (e.g. cleaning staff), and the highest is 90 (judges). For the analysis of the SES among the student body, the distribution is divided into four equally sized groups (quartiles).

In Figure 1, the leftmost bar chart shows the average of the mother's years of education, with the lowest quartile of the distribution (light grey) on the left and the highest quartile (black) on the right. According to the figure above, the parents of the 25% of students whose parents had the fewest years of education had an average of 12 years (which roughly corresponds to the vocational baccalaureate). In the top quartile, the figure was almost 17 years (university degree). The differences in the years of education by SES, as well as in professional prestige, are both significant and contextually important.

Significant differences in competence by SES before the pandemic

In order to contextualize the learning gains from schooling and differences in competence development during the school-free summer break, we will first analyse the differences in competences between children from different socio-economic backgrounds (SES) at a given point in time. Figure 2 shows the estimated values of these differences, in terms of both test scores and teacher assessments, for students in the first grade. To better illustrate these differences, Figure 2 is based on standardised test scores. The mean value is subtracted from the original values and the variance is normalised to one.

It becomes clear that students' competences vary substantially and to a significant degree with the social background of the family. The extent of the disparity becomes apparent when comparing the average competence values between the top and bottom quartiles of the distribution. One group is far above and the other far below the sample average. The average corresponds approximately to the competences of the students in the second quartile. There are differences in the competences of the children from the first and fourth quartiles for all test scores and teacher assessments, amounting to at least 40% of a standard deviation. The gap is most pronounced in linguistic skills, where the difference is approximately one standard deviation. In the samples used here, the teachers' assessments (also shown in Figure 2) roughly correspond to the differences in reading and mathematical skills tested externally by the NEPS. To compensate for this deficit, the students in the lowest group would, on average, require around one additional year of schooling. This shows that inequalities in learning outcomes are already considerable early on in a student's school career, depending on the family environment (see also Blomeyer et al., 2009, 2013). Therefore, in order to meet the demand for equality in education, considerable compensatory investments in education are necessary (e.g. Pfeiffer, 2010).

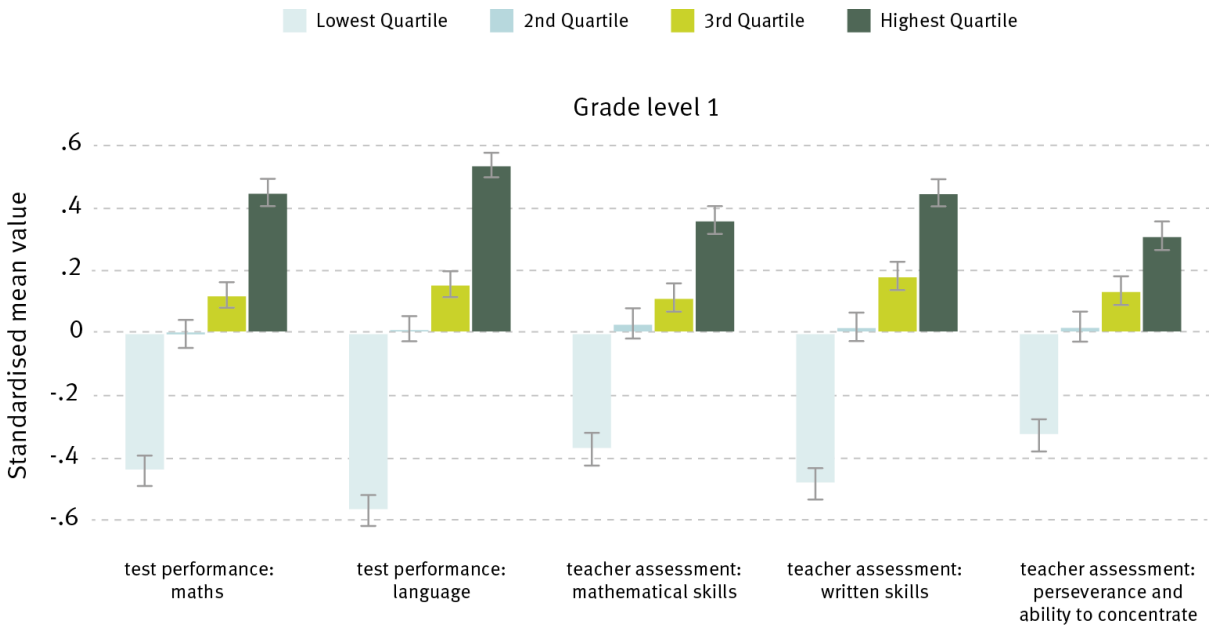

Figure 2

The learning gains at the beginning of primary school are independent

How do competences develop during a month of regular schooling, i.e. before the pandemic? Figure 3 shows the estimated monthly instructional learning gains for grades 1, 2 and 4 for children with different

family environments (SES). Since no test scores for reading skills are recorded in the first grade, the analysis for this grade is limited to mathematical skills.

In Figure 3, the leftmost bar chart shows the learning gains in mathematics in the first year of school according to the four SES groups. Thus, the estimated learning gains vary only slightly with SES. If there are any differences at all (the existing differences in the averages are not statistically significant), then the gains in learning at school are higher in the group of children from the lower SES quartiles than for those from the upper SES quartiles. Children from the lower quartiles thus seem to benefit somewhat more from school as a place of learning in terms of estimated learning gains. On average, the learning gains are significant and amount to slightly more than 10% of a standard deviation during the first two grades - which means that, for example, children in the lowest quartile would need about 4 months more classroom time to catch up with children in the second quartile in mathematics during grade 1. It is only in the 4th grade that the estimated learning gain decreases significantly, and in some cases cannot be statistically distinguished from zero. According to these estimates, a school closure of one month (without other compensatory measures) leads to a significant loss in terms of learning gains, particularly for children in the first two grades.

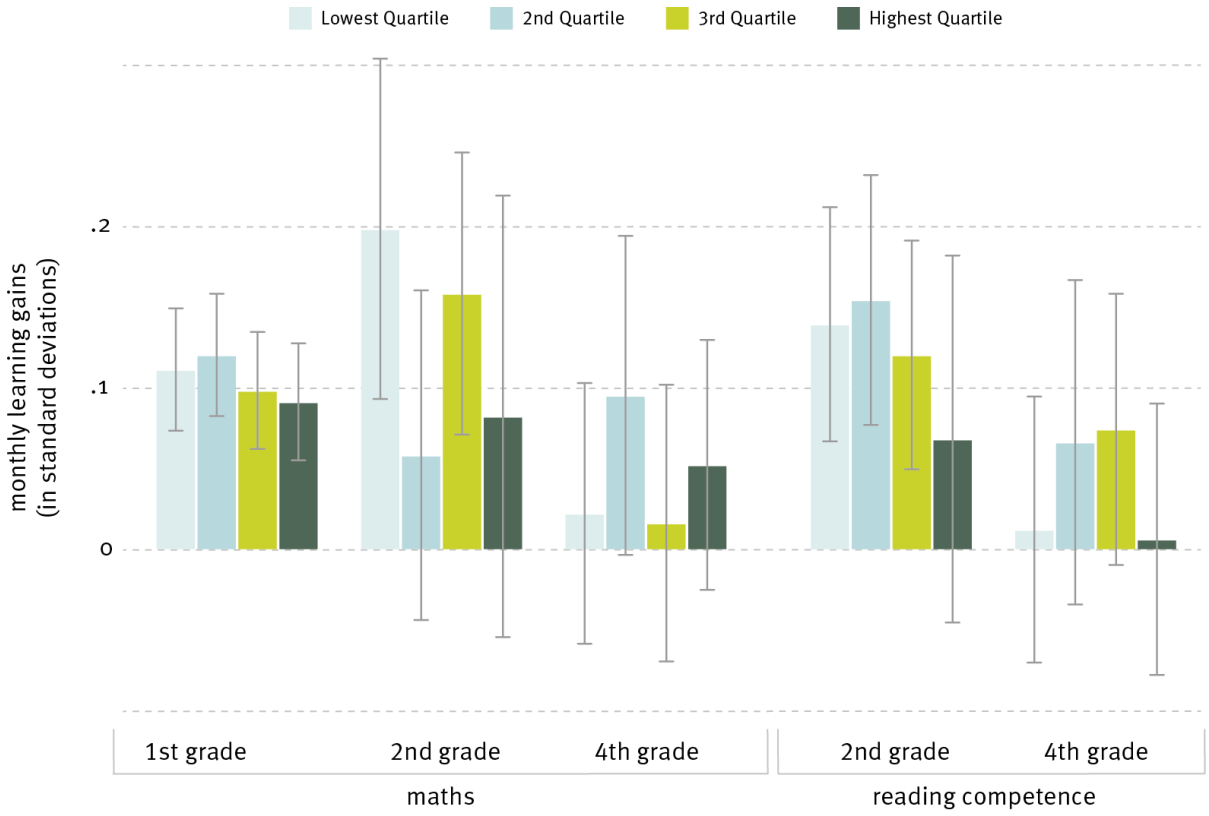

Figure 3

These results cannot be directly extrapolated for a period of three months, or indeed for a whole school year, without first imposing additional assumptions. However, the analysis makes it clear that the absolute learning gains are independent of family background. Thus, school-based learning contributes to a reduction of inequality, although not to the extent that the initial differences disappear. It is therefore inferred that school closures jeopardise the claim of equality in education made by education policy-makers.

Increasing inequality during the school-free period

Next, we investigate the question to what extent competence development during the summer break is influenced by the family's socio-economic background (SES). To this end, we compare the competences of pupils from the same school cohort with different SES at the beginning of 2nd grade, while we use linear regressions to control for competences developed during the 1st grade. Figure 4 shows the learning gains estimated in this way, in addition to the development of perseverance and concentration skills between the 1st and 2nd grade for the second to top SES quartiles relative to the bottom quartile.

In particular, the distance from the lowest to the highest quartile is always considerable, ranging between 10 and 25%. While time in school can thus reduce the estimated differences in academic competence, the gap widens again during the time outside of school. The compensatory effect of primary school attendance is lost during this period. Children whose legal guardians have less education and lower occupational prestige therefore fall behind in terms of learning outcomes after the summer break.

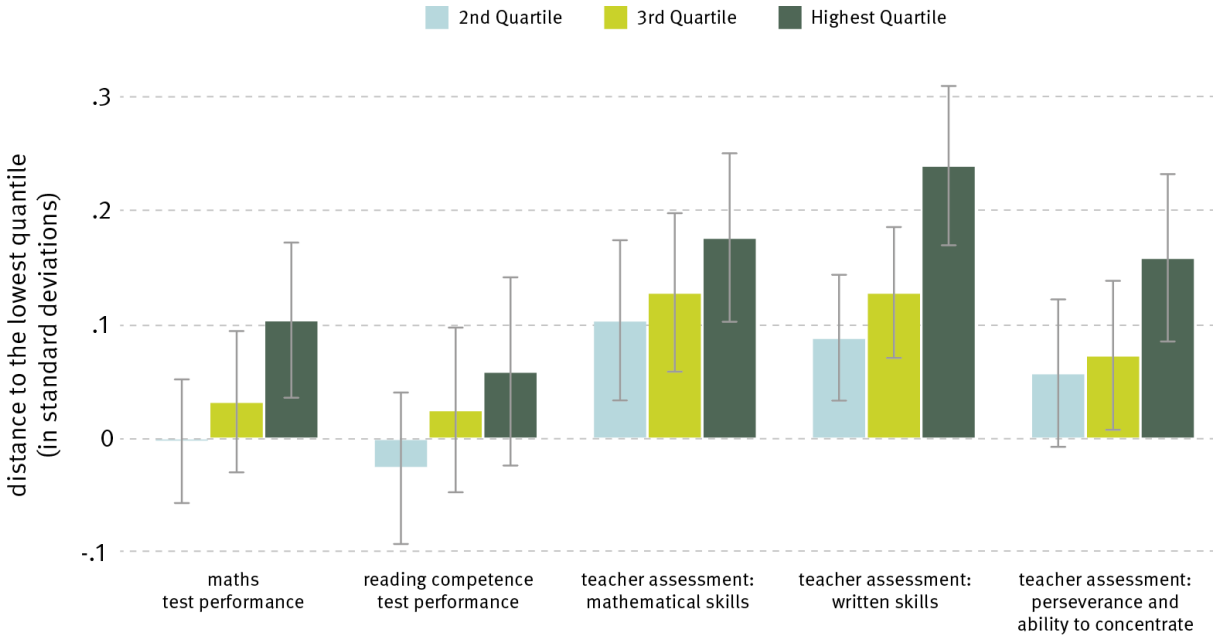

Figure 4

Professionalising learning outside of school

As of yet, there is no evidence of the extent to which any learning losses during the school closures from 18 March 2020 onwards is actually dependent on the family environment. Despite the closures, most schools continued to provide learning materials, and in many cases teaching continued via digital means. Whether and to what extent these measures have contributed to enabling the same learning progress, regardless of SES, cannot be conclusively assessed at present. From the authors' perspective, however, education policy should strive for precisely this goal in order to do justice to the claim of equality in education even under the current COVID-19 circumstances. Due to digital progress, this should be feasible for the first time in the history of schooling.

On the basis of the NEPS data, we have also investigated differences in the extracurricular activities of pupils by SES. Figure 5 shows the proportion of pupils who engage in certain extracurricular activities

outside of school. The sample are the same children as before (i.e. starting cohort 2 of the NEPS), but in the 6th grade and for the 2016/17 school year, since it is only at this point that extracurricular activities were included in the survey. For many activities there are again clear differences after controlling for SES. For example, only around 20% of all children from the lowest quartile read a book or listen to a radio play at least once a day, while over 40% of children from the highest quartile do so. The latter are also more likely to engage in creative activities, such as playing a musical instrument. In comparison, children from the lowest quartile spend more time playing with mobile phones, tablets and computer games, and also spend more time on the internet, social networking sites and watching television. However, there are also similarities. Approximately the same proportion of children say that they study for school at least once per day (50%) or play outside (60%). There seems to still be an access issue for these children, which should be systematically and professionally addressed in the future.

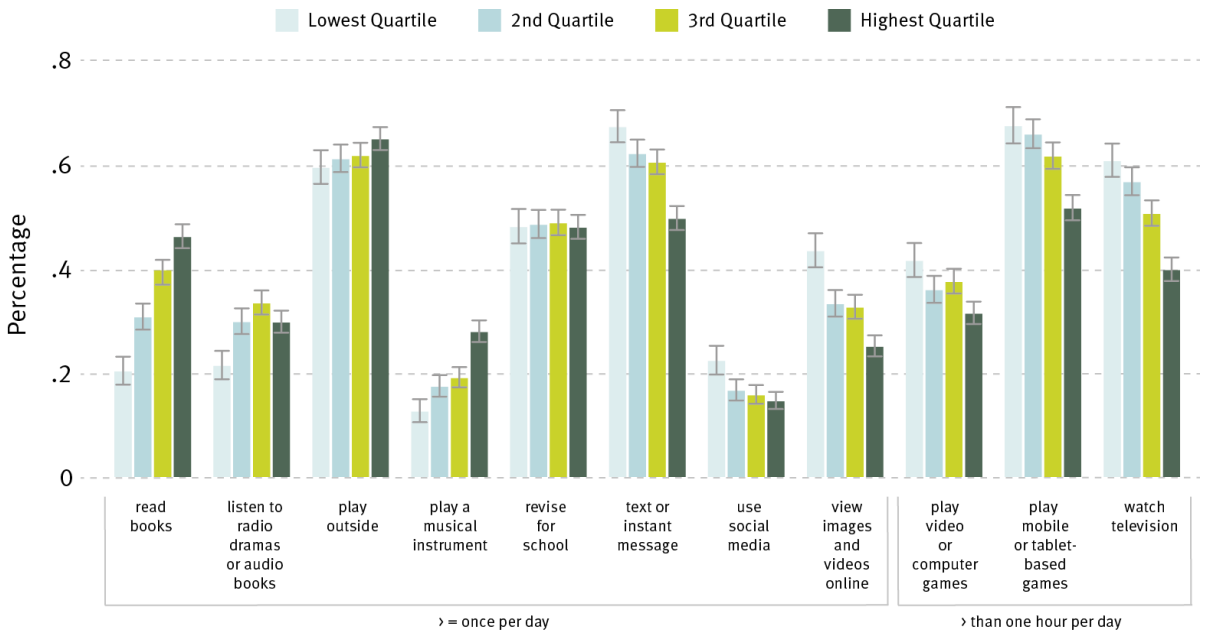

Figure 5

Underutilised learning potential

During the pandemic-related school-free period, or in times of distance learning, families and schools face great challenges. Where is there potential to provide all children with equal educational opportunities? Figure 6 shows the proportion of pupils by SES who, based on information provided by their parents or guardians, own a computer, tablet, mobile phone, television or gaming console. The sample is, as in the analysis of extracurricular activities, the second starting cohort, measured in 6th grade during the 2016/17 academic year.

These evaluations suggest that the proportion of children owning devices that can also be used for digital learning actually tends to decrease with SES. For example, while 38% of children in the lowest quartile have their own tablet, this is only the case for only 20% of children in the highest quartile. From the authors' perspective, the degree of dissemination of digital media indicates there is potential for professional digital interaction that has not yet been sufficiently utilised. Such opportunities should be used to a greater extent to professionalise the learning at home experience, in order to do justice to the

demand for equality in education even when learning is conducted away from the physical school environment.

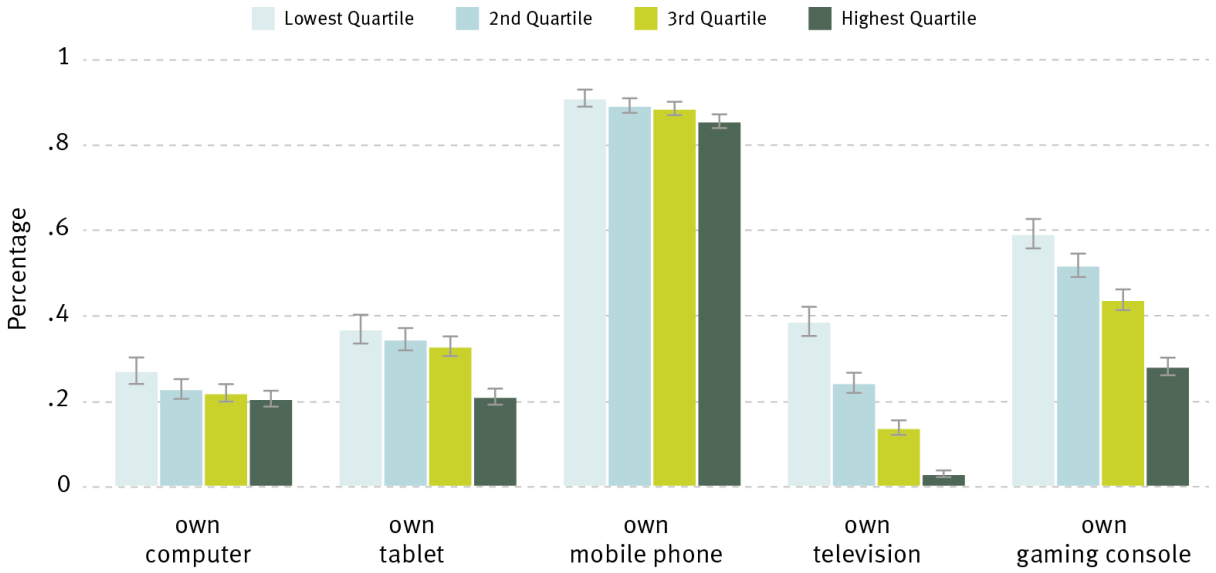

Figure 6

4. Discussion of the Results

Our results indicate that school closures have prevented significant learning gains in the first two grades. The estimated learning gains represent an upper bound, since we do not account for potential compensatory actions offered during the school closures. Younger students seem to be more affected by the closures, partly because the competences acquired at an early age are fundamental for the ongoing acquisition of competences later on in a student's school career. Our analyses confirm existing concerns about an increase in educational inequality due to school closures.

These inequalities concern not only subject-related learning outcomes, such as mathematical and language skills, but also perseverance and concentration skills. The acquisition of these skills can play an equally important role in future development. The fewer years of education that parents or guardians possess, and the lower their occupational prestige, the higher will be the average learning losses in the event of a hypothetical complete school closure. Our evaluation does not find any insurmountable hurdles regarding the availability of electronic devices that could be used for increased digital teaching. According to information provided by parents and guardians, less than 10% of all children do not seem to have their own mobile phone. Suitably equipping all children for increased digital learning would therefore be within reasonable limits, and would not place undue burden on public authorities.

5. Options for Action in Educational Policy: Rethinking Schooling

In the same way that school closures at the beginning of the pandemic sent a strong signal about the threat posed by COVID-19, the re-opening of schools sends a similarly strong optimistic signal about the course of the pandemic. But do the current COVID-19 case numbers allow us to draw such a confident picture of the situation? This is where opinions differ. In any case, it cannot be ruled out that there may

be more severe restrictions on in-person learning in the future.

Moreover, public discourse seems to be too fixated on the question of "schools re-opening, yes or no?" From the authors' perspective, it is much more important to develop learning formats that ensure learning outcomes are independent of family background, even in times of school closure. This study clearly indicates that the distribution of competences at school is strongly dependent on the parents' education and occupational prestige right from the outset. However, the estimated increases in learning during the 1st and 2nd years of primary school are much less dependent on these factors. Since all pupils find a comparable learning environment while physically in the classroom, they are able to learn approximately the same amount during their time in school. Periods when schools are closed therefore increase inequality, particularly for students in the first few years of primary school.

In order to ensure the principle of equality is upheld, even in the event of school closures, it is important to professionalise learning outside of the classroom and to compensate for the influence of the family environment where possible. This includes professionalised digital interaction opportunities even outside of the classroom environment. Mentoring programmes serve as a positive example here, whose positive results can be built upon (e.g. Kosse et al., 2020). To pursue the goal of providing all children with as comparable a learning environment as possible, the pandemic should be used to restructure professional teaching. This re-thinking of teaching should not stop at the physical boundaries of the classroom, and should be more systematically committed to the principle of equality from the outset.

References

Adda, J. (2016). Economic activity and the spread of viral diseases: Evidence from high frequency data. *The Quarterly Journal of Economics*, 131(2), 891-941.

Baggio, S., Arnaud, Gl, Yerly, S., Bellon, M., Wagner, N., Rohr, Ml, ... & Jacquerioz, F. (2020). SARS-CoV-2 viral load in the upper respiratory tract of children and adults with early acute COVID-19. *Clinical Infectios Diseases*.

Blomeyer, D. Coneus, K., Laucht, M. & Pfeiffer, F. (2009). Initial Risk Matrix, Home Resources, Ability Development and Children's Achievement. *Journal of the European Economic Association* 7(2-3), 638-648.

Blossfeld, H.-P., H.-G. Roßbach und J. von Maurice (Hrsg.) (2011). Education as a Lifelong Process – The German National Educational Panel Study (NEPS). *Zeitschrift für Erziehungswissenschaft*: Sonderheft 14, 19-34.

Dehning, J., Zierenberg, J., Spitzner, F. P., Wibral, M., Neto, J. P., Wilczek, M., & Priesemann, V. (2020). Inferring change points in the spread of COVID-19 reveals the effectiveness of interventions. *Science* 369(6500).

Ganzeboom, H., Graaf, P. & Treiman, D. (1992). A Standard Socio-Economic Index of Occupational Status. *Social Science Research* 21, 1-56

Heald-Sargent, T., Muller, W. J., Zheng, X., Rippe, J., Patel, A. B., & Kociolek, L. K. (2020). Age-related differences in nasopharyngeal severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) levels in patients with mild to moderate coronavirus disease 2019 (COVID-19). *JAMA Pediatrics*. Published online July 30, 2020.

Kosse, F., Deckers, T., Pinger, P., Schildberg-Hörisch, H., & Falk, A. (2020). The formation of prosociality: causal evidence on the role of social environment. *Journal of Political Economy* 128(2), 434-467.

Levinson, M., Cevik, M., & Lipsitch, M. (2020). Reopening Primary Schools during the Pandemic. *New England Journal of Medicine*. Published online July 29, 2020

Litvinova M, Liu QH, Kulikov ES, & Ajelli M. (2019). Reactive school closure weakens the network of social interactions and reduces the spread of influenza. *Proc Natl Acad Sci* 116(27), 13174-13181.

Ludvigsson, J. F. (2020). Children are unlikely to be the main drivers of the COVID-19 pandemic–a systematic review. Acta Paediatrica 109, 1525– 1530.

Neidhöfer, G., & Neidhöfer, C. (2020). The effectiveness of school closures and other pre-lockdown COVID-19 mitigation strategies in Argentina, Italy, and South Korea. *ZEW-Centre for European Economic Research* Discussion Paper, (20-034).

Pfeiffer, F. (2010). Entwicklung und Ungleichheit von Fähigkeiten: Anmerkungen aus ökonomischer Sicht, in: H.-H. Krüger, U. Rabe-Kleberg, R.-T. Kramer and J. Bude (Hg.) *Bildungsungleichheit revisited. Bildung und soziale Ungleichheit vom Kindergarten bis zur Hochschule*. Studien zur Schul- und Bildungsforschung Vol. 30. Wiesbaden, Verlag für Sozialwissenschaften, 2010, 25-44.

Wendt H., Kasper D., Bos W., Vennemann M., Goy M. (2017) Wie viele Punkte auf der TIMSS-Metrik entsprechen einem Lernjahr?. In: Eckert T., Gniewosz B. (Hg.) *Bildungsgerechtigkeit*. Springer VS,

Wiesbaden.

This study uses data from the National Education Panel (NEPS): Starting Cohort Kindergarten, doi:10.5157/NEPS:SC2:8.0.1. The NEPS data was collected from 2008 to 2013 as part of the National Framework Program for the Promotion of Empirical Educational Research, which was funded by the German Federal Ministry of Education and Research (BMBF). Since 2014, NEPS has been maintained by the Leibniz Institute for Educational Pathways e.V. (LIfBi) at the Otto-Friedrich-University Bamberg in cooperation with a nationwide network.

Authors

Maximilian Bach*
ZEW – Leibniz Centre for European Economic Research
L 7, 1
68161 Mannheim
www.zew.de
maximilian.bach@zew.de

Dr. Guido Neidhöfer*
ZEW – Leibniz Centre for European Economic Research
L 7, 1
68161 Mannheim
www.zew.de
guido.neidhoefer@zew.de

Sarah McNamara
ZEW – Leibniz Centre for European Economic Research
L 7, 1
68161 Mannheim
www.zew.de
sarah.mcnamara@zew.de

PD Dr. Friedhelm Pfeiffer
ZEW – Leibniz Centre for European Economic Research
L 7, 1
68161 Mannheim
www.zew.de
friedhelm.pfeiffer@zew.de

* Contact person for inquiries

ZEW Expert Brief

Publisher: ZEW – Leibniz Centre for European Economic Research
L 7, 1 · 68161 Mannheim · Germany · info@zew.de · www.zew.de/en · twitter.com/ZEW_en
President: Prof. Achim Wambach, PhD · Managing Director: Thomas Kohl
Editorial responsibility: Carola Hesch · cvd@zew.de

Leibniz Association

ZEW