Effects of COVID-19-Related School Closures on Student Achievement—A Systematic Review

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Author Note

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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Abstract

The COVID-19 pandemic led to numerous governments deciding to close schools for several weeks in spring 2020. Empirical evidence on the impact of COVID-19-related school closures on academic achievement is only just emerging in the literature. The present work aimed to provide a first systematic overview of evidence-based studies on general and differential effects of COVID-19-related school closures in spring 2020 on student achievement in K–12. The findings indicate a considerably negative effect of school closures on student achievement specifically in younger students and students from families with low socioeconomic status. At the same time, certain measures can be identified that might mitigate these negative effects. The findings are discussed in the context of their possible consequences for future national educational policies when facing future school closures.

Keywords: COVID-19, school closure, student achievement, learning loss

Effects of COVID-19-Related School Closures on Student Achievement—A Systematic Review

In spring 2020, the COVID-19 pandemic caused severe disruption to everyday life around the world. As one of several measures taken to prevent the spread of the virus, many governments closed schools for several weeks or months. Although school closures are considered to be one of the most efficient interventions to curb the spread of the virus (Haug et al., 2020), many educators and researchers raised concerns about the effects of COVID-19-related school closures on student academic achievement and learning inequalities. For instance, Woessmann (2020) estimated a negative effect of 0.10 *SD* on student achievement due to COVID-19-related school closures. Moreover, Haeck and LeFebvre (2020) estimated that socioeconomic achievement gaps would increase by up to 30%.

The negative effects of school closures due to summer vacation or natural disasters, and of absenteeism on student achievement are already well documented in the literature (for an overview see Kuhfeld, Soland, et al., 2020). Less is known, however, about the impact of COVID-19-related school closures on student achievement. The primary focus of the literature on COVID-19-related school closures to date was on the reception and use of digital learning technologies and remote learning (Andrew et al., 2020; Blume et al., 2021; Grewenig et al., 2020; Maity et al., 2020; Pensiero et al., 2020). Moreover, the psychological impact of COVID-19-related school closures, the use of school counseling in connection with COVID-19 (Ehrler et al., 2020; Gadermann et al., 2021; O'Sullivan et al., 2021; Xie et al., 2020; O'Connor, 2020), and the effects of the school closures on student motivation (Zaccoletti et al., 2020; Smith et al. 2021) were investigated. Existing projections of the impact of COVID-19 on student achievement paint quite a bleak picture; a learning loss of up to 38 points on the PISA scale is

estimated, which corresponds to 0.9 school years (Azevedo et al., 2020; Iqbal & Geven, 2020; Kaffenberger, 2021; Kuhfeld et al., 2020; Wyse et al., 2020).

Thus, a year into the pandemic, it is a good time for a first stocktaking of the actual, evidence-based impact of COVID-19-related school closures on student achievement. Consequently, the present work aimed to answer two research questions. First, what was the general effect of COVID-19-related school closures in spring 2020 on student achievement in K–12 education? Second, did school closures have differential effects on specific student groups?

The review is structured as follows. We first illustrate our systematic literature search, the inclusion criteria, and the synthesis of the relevant information from the studies selected. We then report the general and differential effects of the COVID-19-related school closures on student achievement, which are discussed in the context of their possible consequences for future national educational policies.

Method

Literature Search

To identify relevant studies that investigated the effect of COVID-19-related school closures on student achievement, we searched the Web of Science database for articles published between March 1, 2020 and April 30, 2021. We used the following keywords and search string: [Covid OR Corona OR "SARS-CoV-2" AND school AND learn* OR "test score" OR performance OR competenc* OR achievement OR grades]. The results were refined by using the following categories: education, educational research, economics, education scientific disciplines, psychology educational, psychology multidisciplinary, social sciences interdisciplinary, and education special. The indexes searched were SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, and IC. Because

the COVID-19 pandemic was still ongoing at the time this review was written, and the field of research on the effects of COVID-19-related school closures on student achievement is rapidly evolving, we additionally searched the preprint servers PsyArXiv, EdArXiv, and SocArXiv using the aforementioned keywords. With this initial literature search, we obtained a total of 601 potentially relevant studies. After selecting relevant articles out of these studies, we used the *backward reference searching* method (i.e., examining the works cited in the selected articles) to identify additional potentially relevant studies.

Selection of Studies

The abstracts of the studies selected were carefully read by the authors, and further inclusion was decided based on the following initial criteria. The studies (1) had to have a clear focus on COVID-19-related school closures, they (2) had to focus on K–12 education, and they (3) had to have student achievement (or test scores) as the dependent variable. This initial selection left 109 studies for potential inclusion in the review. These studies were thoroughly read by the authors and two research assistants. The decision to include studies in the review was then based on the following primary set of inclusion criteria: Studies were required (1) to have collected actual data prior to and during/after COVID-19-related school closures, and (2) to have applied statistical analyses and to report an effect size. This set of inclusion criteria was chosen in order to select studies that provided the aforementioned evidence-based insights. Thus, reviews or discussions on how COVID-19 affects educational processes were excluded. Likewise, exploratory analyses or simple surveys (where only percentages were reported) were also excluded. To determine the degree of rater agreement on the selection of the studies, a randomly selected subset of 20 studies was evaluated by both the authors and the research assistants. Any remaining divergent evaluations were highlighted in the evaluation forms and

subsequently discussed. The second selection procedure yielded nine studies that were suitable for inclusion in the review. Subsequently, a backward search of references within the nine selected studies yielded two additional studies, which were then also included in the review.

Synthesis

We synthesized the 11 studies by extracting the following information that was relevant for our research questions: (1) country, (2) duration of school closure, (3) sample description (type of school and sample size), (4) subjects for which student achievement was investigated, (5) statistical method, (6) general effects of the COVID-19-related school closures on student achievement, and (7) differential effects as reported by subgroup analyses; see Table 1 for a detailed list of the studies included.

Results

General Effects of COVID-19-Related School Closures on Student Achievement

The studies on the effect of COVID-19-related school closures on student achievement selected for our review reported mixed findings, with effects ranging from -0.37 *SD* to +0.20 *SD* (*Mdn* = -0.10 *SD*). For mathematics, effects varied between +0.20 *SD* and -0.19 *SD* (*Mdn* = -0.12 *SD*), with seven studies reporting a negative effect (Clark et al., 2020; Depping et al., 2021; Engzell et al., 2021; Kuhfeld, Ruzek, et al., 2020; Maldonado & De Witte, 2020; Schult et al., 2021; Tomasik et al., 2020) and three studies reporting a positive effect (Gore et al., 2021; Meeter, 2021; Spitzer & Musslick, 2020) of COVID-19-related school closures on student achievement in mathematics. For reading, the effects found varied between -0.29 *SD* and +0.04 *SD* (*Mdn* = -0.14 *SD*), with six studies reporting a negative effect (Clark et al., 2020; Depping et al., 2021; Engzell et al., 2021; Maldonado & De Witte, 2020; Schult et al., 2021; Tomasik et al., 2020) and one study reporting a positive effect (Gore et al., 2021) of COVID-19-

related school closures on student achievement in reading. For French as a foreign language, one study reported a large learning loss of 0.30 *SD* (Maldonado & De Witte, 2020), while another study reported an increase in correct solutions within a French learning program (van der Velde et al., 2021) during the COVID-19-related school closures. As for other subjects, Maldonado and De Witte (2020) found achievement in science to be negatively influenced by -0.33 *SD*, while achievement in social sciences was less strongly influenced (-0.08 *SD*).

Differential Effects on Groups of Students

The studies selected for our review reported several differential effects of COVID-19-related school closures on student achievement in different groups of students. The main finding was that younger children seemed to be more negatively affected in their learning (-0.37 *SD* vs. -0.10 *SD*; Tomasik et al., 2020). Moreover, children from families with a low socioeconomic status (SES) seemed to be more affected than children from families with a high SES (Engzell et al., 2021; Maldonado & De Witte, 2020). One study reported an interaction between grade and SES, that is, for younger children from schools with low school-level SES, learning losses of 0.16 *SD* were found, while younger children from schools with medium school-level SES experienced learning gains of 0.15 *SD* (Gore et al., 2021). Additionally, low-performing students were more affected by COVID-19-related school closures in mathematics, while high-performing students were more affected by COVID-19-related school closures in reading (Schult et al., 2021). Finally, low-performing students benefited more from systematic online learning methods (Clark et al., 2020; Spitzer & Musslick, 2021).

Discussion

The present work aimed to provide a first systematic overview of studies that reported effects of COVID-19-related school closures on student achievement and to answer two research

questions. First, what was the general effect of COVID-19-related school closures in spring 2020 on student achievement in K–12? Second, did school closures have differential effects on specific student groups?

In sum, there is clear evidence for a negative effect of COVID-19-related school closures on student achievement. The reported effects are comparable in size to findings of research on summer losses (d = -0.005 *SD* to -0.05 *SD* per week; see also Kuhfeld et al., 2021) and are slightly larger than Woessmann's initial estimate. Hence, even though remote learning was implemented during COVID-19-related school closures, the effects achieved by remote learning were similar to those achieved when no teaching was implemented at all during summer vacation. Alarmingly, specifically younger children (Tomasik et al., 2020) and children from families with a low SES (Engzell et al., 2021; Maldonado & De Witte, 2020) were negatively affected by COVID-19-related school closures. This finding is in line with predictions of widening learning gaps and additive learning losses in subsequent school years (Grewenig et al., 2020; Haeck & LeFebvre, 2020; Kaffenberger, 2020; Pensiero et al., 2020). This indicates that most remote learning measures implemented during the first school closures in spring 2020 were not effective for student learning; there was no difference between them and the absence of systematic teaching during summer vacation. Taking a closer look at studies that reported positive effects of school closures on student achievement, three of these studies (Meeter, 2021; Spitzer & Musslick, 2020; van der Velde et al., 2021) used some kind of online learning software to assess student achievement. Students in the studies of both Meeter (2021) and Spitzer and Musslick (2020) worked with online learning software for mathematics, and students in the study of van der Velde et al. (2021) worked on online learning software for language learning (i.e., for French). Hence, the positive effects of COVID-19-related school closures on performance in

such online learning programs may have occurred due to the increased use of software during school closures. Additionally, Spitzer and Musslick (2020) reported that low-performing students benefited even more than high-performing students regarding their performance during COVID-19-related school closures from using the learning software. The authors explained this finding by considering that low-performing students were potentially less distracted by other students in a home-learning setting. These findings are in line with results by Clark et al. (2020), showing low-performing students to specifically benefit from systematic online material.

The first COVID-19-related school closures in spring 2020 were followed by similar measures in the fall and winter of 2020/2021. Due to the cumulative nature of learning processes and student achievement, additional learning losses are likely. Nevertheless, school closures do not seem to be initiated as quickly now as they were at the beginning of the pandemic, which is positive for learning. To counter the learning losses, on a micro level, educational policy makers should determine potential supportive measures that increase the active learning time on task. On a macro level, national policy makers should determine potential compensatory measures to support students in their learning and to avoid failed educational careers. In this regard, systematic online material and software have been found to compensate for learning losses, specifically in high-risk children. Hence, educational policy makers and educators should be aware of the importance of providing children with systematic material and ensuring that high-risk children, in particular, have access to adequate learning environments in order to circumvent learning losses and widening learning gaps that may be caused by subsequent school closures.

The goal of this systematic review was to provide a first evidence-based insight into the effects of COVID-19-related school closures on student achievement in K–12 education. The onus is now on national educational policy makers to be aware of these effects and, together with

educational and psychological research fields, to work towards the implementation of measures to mitigate or even counteract these negative effects. This may be one of the most important societal tasks for the post-COVID time.

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Table 1

Descriptive Criteria of Studies Included

Authors (Country)	Duration of School Closure	Type of School	Sample Size	Subjects	Statistical Method	General Effect	Differential Effects
Clark et al. (China)	7 weeks	Secondary	1,835	Reading, Mathematics, English, Politics, History	DiD Regression	-0.22 *SD*	Larger effect in girls Larger effect in low-achieving students
Depping et al. (Germany)	8 weeks	Elementary and Secondary	~ 27,500	Reading, Mathematics	Difference Analyses	up to -.18 *SD* (reading) up to -.19 *SD* (mathematics)	Larger effect in older children
Engzell et al. (Netherlands)	8 weeks	Elementary and Secondary	350,000	Reading, Mathematics	DiD Regression	-0.09 *SD* (reading) -0.14 *SD* (mathematics)	+60% learning loss in low-SES students
Gore et al. (Australia)	8 weeks	Elementary	> 4,800	Reading, Mathematics	Linear Mixed Models	+0.04 *SD* (reading) +0.06 *SD* (mathematics)	Grade 3 in mathematics: -0.16 *SD* for low school-level SES +0.15 *SD* for medium school-level SES
Kuhfeld, Ruzek, et al. (USA)	8 weeks	Elementary and Secondary	~ 7 Million	Reading, Mathematics	Change Score Analyses	-5 to -10 points of percentile scores (mathematics)	Likely differences for different ethnicities
Maldonado & De Witte (Belgium)	7 weeks	Elementary	> 4,000	Reading, Mathematics, Social Sciences, Science, French	DiD Regression	-0.29 *SD* (reading) -0.19 *SD* (mathematics)	Larger effect in low-SES students
Meeter (Netherlands)	8 weeks	Elementary	~ 95,000	Mathematics	ANOVA	+0.20 *SD*	—

Table 1 Continued

Authors (Country)	Duration of School Closure	Type of School	Sample Size	Subjects	Statistical Method	General Effect	Differential Effects
Schult et al. (Germany)	8 weeks	Secondary	~ 80,000	Reading, Mathematics	Change Score Analyses	-0.07 *SD* (reading) -0.09 *SD* to -0.03 *SD* (mathematics)	Larger effect on reading in high-performing students, larger effect on mathematics in low-performing students
Spitzer & Musslick (Germany)	8 weeks	Elementary and Secondary	> 2,500	Mathematics	Linear Mixed Models	-2.43% (error rate)	Larger improvements in low-achieving students
Tomasik et al. (Switzerland)	8 weeks	Elementary and Secondary	26,685	Reading, Mathematics	Growth Curve Models	-0.37 *SD* (elementary school) -0.10 *SD* (secondary school)	Larger effect in younger students, larger effect in high-performing students
van der Velde et al. (Netherlands)	8 weeks	Secondary	133,450	French	Linear Mixed Models	+6% (correct solutions to open questions)	—