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Reading skills intervention during the Covid-19 pandemic

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This paper diagnoses the reading skills at the onset of second grade after one (final) trimester of first grade, with online schooling as a result of COVID-19. It also describes and assesses the impact of a Reading Skills Consolidating Program conducted with second graders during the first weeks of the school year. This intervention program focuses on the promotion of letter-sound, phonemic awareness, decoding and spelling. The intervention was implemented with 446-second graders (224 boys and 208 girls), preceded and followed by a reading assessment. Results were analyzed with an intra (pre- and post-test) group design. A paired sample *t*-test indicated the presence of statistically significant differences between the two assessment moments, with higher values at the post-test. At the pre-test, there was a significantly higher than the normally expected percentage of students with a reading level on or below the 10th percentile along with a significantly worse performance among low Socioeconomic Status (SES) students. The post-test revealed a positive impact of the training program, as indicated by (i) a decrease to about half of the number of students at or below the 10th percentile, (ii) an increase of 20% of students with reading skills at or above the 30th percentile and (iii) the difference decrease in reading skills in a result of SES.

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The global pandemic of SARS-CoV-2 (COVID-19 [coronavirus disease 2019]) has completely changed education in many countries around the world (Reimer et al., 2021). Students had face-to-face instruction interrupted during the 2019–2020 school year due to the pandemic (Kuhfeld et al., 2021). The majority of schools provided some virtual instruction during the last months of school in 2019 (Lake and Dusseault, 2020), and the same scenario reoccurred at the beginning of 2021. Throughout this time, both educators and parents have been actively seeking the best way to continue formal education through remote or virtual learning (Daniel, 2020; Hodges et al., 2020; Reich et al., 2020). Nonetheless, it remains unclear how effective remote or virtual learning is (Viner et al., 2020).

Longer-term economic and societal implications of remote or virtual learning seem likely to be severe. Consequently, it will also have a direct impact on both short- and long-term school experiences and trajectories. For example, in short-term, research has shown that COVID-19 school closures will generate substantial learning losses, particularly for the lowest-achieving students (Bacher-Hicks et al., 2020; Chetty et al., 2020; Kuhfeld et al., 2021) and this can have long-term implications, since impairments in reading and writing acquisition skills have the potential to seriously limit personal aspirations (Jamshidifarsani et al., 2019). Furthermore, research anticipates that virtual learning will emphasize social inequality in student learning due to differences in children's opportunities to learn at home (Bol, 2020), as many working parents were struggling to work and take care of their children at the same time (Harris, 2020). Parents identify personal, technical, logistical and financial barriers regarding the challenges of distance learning during the Pandemic (Abuhammad, 2020). Parents generally had negative beliefs about the benefits of online learning and preferred traditional learning in early childhood settings (Dong et al., 2020). Parents tended to resist online learning for four main reasons: the shortcomings of online learning, young children's inadequate self-regulation, lack of time and professional knowledge for supporting children's online learning (Dong et al., 2020). Summing up, research reports a close association between parental level of education and the ability to support children's remote learning during the pandemic (Azubuike et al., 2021).

Children from disadvantaged families received much less academic support from their parents and were less likely to have access to necessary physical resources such as a computer or a tablet (Azubuike et al., 2021; Andrew et al., 2020; Bol, 2020). In Portugal, a report from the Court of Auditors (Machado et al., 2021) states that four in every five students did not have access to technological equipment and had difficulties with internet access. The Portuguese Ministry of Education acquired 100 thousand pieces of equipment, in March 2020, to be delivered to schools and then distributed to needy students. However, authorization for the acquisition and distribution of technological equipment was late (Machado et al., 2021). In January 2021, only 27% of the 100 thousand pieces of equipment had been delivered to the students. The Portuguese government answer did not come on time to strike the inequalities in digital literacy and access to technological equipment that the Pandemic imposed. Additional research based on the borrowing of children's books from libraries shows that social inequality visibly increased during the lockdown (Jæger and Blaabæk, 2020; Reimer et al., 2021). Even though reading books to children does not substitute the critical role of formal education in teaching children how to read, the literature shows that children whose parents read to them daily during the pandemic, had less loss compared to those whose parents did not read to them (Bao et al., 2020). Consequently, differences in children's reading activities during the pandemic

might accelerate pre-existing social differences in children's cognitive skills.

Based on these results, it is important to intervene as early as possible in order to help children that have seen their school year affected by the pandemic. If reading disabilities are not early addressed, difficulties tend to generalize to other domains, thus jeopardizing future knowledge acquisition (Raspin et al., 2019), exposing students to consecutive experiences of failure, thereby diminishing their motivation to learn (Lyytinen and Erskine, 2016). Conversely, when these difficulties are identified early and are accompanied by a prompt and intensive intervention, the likelihood of reversing trajectories is very high (Hall and Burns, 2018; Lyytinen, 2008).

In this study, we focus on an intervention program specifically designed for training second graders reading skills right from the beginning of the school year, after one (final) trimester of first grade with schools closed during the 2019–2020 school year.

The RSCP—Reading Skills Consolidation Program

This intervention program occurred as part of a broader project, aiming to intervene with kindergarteners, first and second graders. The main goal of the project, like other international ones (e.g., Jamshidifarsani et al., 2019; Solheim et al., 2018), is early intervention with children training the alphabetic principle through phonemic awareness and letter-sound correspondence (pre-reading skills), as well as the spelling and decoding processes (reading skills), which are the foundations for fluency and reading comprehension. These skills are aligned with the Portuguese guidelines for basic education (DGE, 2015).

The RSCP consists of ten activities, to be developed over five sessions, aiming to promote decoding competence. There were two intervention options: option A was aimed exclusively at promoting alphabetical decoding, targeting children with highly fragile skills (at letter-sound level); option B consisted of five sessions for the promotion of alphabetical decoding, later evolving to the developing of orthographic decoding, targeting children, also, with fragile skills (but in this case, with letter-sound knowledge already acquired). The choice of which option to adopt was made by the teacher based on the individual results of the reading assessment conducted before the intervention. One activity example of the intervention in option A is the “letters clothesline”. In this activity, the teacher hangs a set of letters on the clothesline (for example in this order: /p/, /m/, /v/, /j/, /d/ and /r/) and asks one student to throw the dice. Regarding the number the dice shows, another student has to write down a word that starts with the same letter (for example, the dice shows a six, which means, the student has to write a word that starts with the letter /r/). In the next round, another student throws the dice and another student spells a new word. An example of an activity in option B is the “change the syllables”. In this activity, the teacher writes a word in a roll (kitchen paper roll for example) and cut the roll into rings (one per syllable). Using a pen, the teacher hangs the rings in the pen to set a word and asks the student to read. In order to continue the activity, the teacher changes the syllable sequence. The program was implemented by educational and clinical professionals of the broader project, along with the classroom teacher, under the supervision of the coordinator of the project.

This study aims to diagnose the reading skills of children at the beginning of the second grade after the previous entire last trimester in first grade with closed schools, as well as to analyze whether the impact differed according to SES. We further present preliminary results regarding the impact of the RSCP, as a means of remediating (or ameliorating) the negative effects from the previous trimester.

Table 1 Number of students per time assessment and school.

Pre-intervention (September) (N = 542)				Post-intervention (October/November) (N = 446)			
NTEIP		TEIP		NTEIP		TEIP	
Schools	Students	Schools	Students	Schools	Students	Schools	Students
School 1	34	School 1	36	School 1	33	School 1	35
School 2	23	School 2	20	School 2	43	School 2	19
School 3	39	School 3	18	School 3	15	School 3	16
School 4	45	School 4	29	School 4	11	School 4	29
School 5	16	School 5	22	School 5	31	School 5	19
School 6	13	School 6	15	School 6	39	School 6	15
School 7	36	School 7	45	School 7	28	School 7	41
School 8	41	School 8	19			School 8	18
School 9	33	School 9	22			School 9	20
		School 10	36			School 10	34
Total	280	Total	262	Total	200	Total	246

Methods

Participants. At the pre-intervention assessment T1 (beginning of the school year - September) 542-second graders were assessed, 256 (47.2%) girls and 286 (52.8%) boys, attending public school (19 schools) in the North Coast of Portugal. From these, 280 (51.7%) students were attending NTEIP Schools¹ (*Territórios Educativos de Intervenção Não Prioritária* [Non Priority Intervention Educational Territories]) and 262 (48.3%) TEIP Schools (*Territórios Educativos de Intervenção Prioritária* [Priority Intervention Educational Territories]). At the post-intervention T2, 446 students were assessed, 224 (50.2%) boys and 208 (46.6%) girls, in 17 schools. Of these, 200 (44.8%) belong to NTEIP School Groupings and 262 (55.2%) to TEIP School Groupings. A description of the participants per School Grouping is presented in Table 1.

Instruments. Demographic variables were assessed through a survey built for that purpose (e.g., age, sex, school, SES). The SES was assessed by the type of school (NTEIP/TEIP). Children from NTEIP were considered from average SES and children from TEIP from low SES. Participants were assessed regarding reading skills with the *Teste de Rastreio de Leitura-TRL* [Screening Test for Reading] (Silva et al., 2020). TRL is an early reading ability screening test, developed for Portuguese speaking first graders. The test consists of 30 incomplete sentences (items), which the reader must read and complete by selecting one of four given alternatives using multiple choice. Across the four alternatives, one is the target word and the remaining three are distractors. Distractors are words or pseudo-words that are visually and/or phonologically close to the target word. (e.g., “*Paga o bolo com a: noda, mopa, bota, nota*” [Pay the cake with the: noda/mopa/boot/money - the additional options are pseudowords]; or “*O pai vai à: jola, mola, loja, dota*” [The father goes to the: jola, clothespin, store, dota]). From the 30 sentences (items), 20 are orthographically simple words (words with consonant-vowel structure, e.g., boca [mouth]), and 10 are orthographically complex words (words with consonant-vowel-consonant - festa-; consonant- diphthong -bailado-; and consonant-consonant-vowel - florista -). The total score corresponds to the total number of sentences completed correctly by the child in five minutes. The maximum score is 30 points.

Procedures of data collection and data analysis. Authorizations were obtained from the school board and parents/legal guardians. The assessment goals were presented to parents/legal guardians, and the confidentiality of the data processing was guaranteed. Participants were administered the assessment tasks individually before the beginning of the intervention (in the last 2 weeks of

Table 2 Percentile distribution in T1 (n = 542).

	N	%
≤P10	144	26.6
>P10 ≤ P30	102	18.8
>P30	296	54.6

September 2020) and after the intervention (5 weeks later). All second graders of 19 schools located on the North Coast of Portugal were selected for the intervention. Students included in the intervention program were not receiving any extra intervention regarding reading and writing abilities. There was a decrease between the number of participants who were evaluated at the beginning of the school year and those who completed the intervention as a result of quarantining measures (n = 96, 18%). As a result of COVID-19 outbreaks, entire classes and/or the teacher were confined at home so the post-assessment was not conducted with all participants assessed at pre-test.

Statistical analyses were performed through the *Statistical Package for the Social Sciences* for Windows, version 26.0. Statistical analyses were used to characterize the participants according to SES. A paired sample t-test to verify the effect of time on reading skills was conducted. Before running this test, we verified the fulfillment of normal distribution. Once fulfillment of normal distribution was not verified, non-parametric tests were conducted. When the results of non-parametric tests showed the same conclusions (rejection of the null hypothesis), the results of the parametric tests were reported.

Results

Time 1—pre-intervention. At the pre-intervention assessment, the mean of accurate answers in the TRL was 12.3 (SD = 10). The distribution of the TRL results per percentile is described in Table 2. We can observe that 27% of the students had reading skills at or below P10, a percentage that increases to 45% if we set the cut-off point at results equal to or less than P30.

At the beginning of the second-grade average SES children presented significantly better reading results than low SES children $t(540) = 2.46 p = 0.01$ (Table 3).

In Table 4 the percentile distribution is detailed according to the SES. We can observe a higher percentage of children with results at P10 or below in low SES (31.7% vs. 21.8%); conversely, results above the P30 are lower for low SES in comparison to average SES children (50 vs. 58.9%).

Table 3 Average of correct answers by educational territory in T1.

SES			
	Average SES (n = 280) Mean (SD)	Low SES (n = 262) Mean (SD)	t(540)
Number of sentences read accurately	13.30 (10.05)	11.19 (9.87)	2.46*

*p < 0.05.

Table 4 Percentile distribution of results in T1, by SES.

	Average SES		Low SES	
	n	%	n	%
≤P10	61	21.8	83	31.7
>P30 ≤ P30	54	19.3	48	18.3
>P30	165	58.9	131	50

Table 6 Percentile distribution at T1 and T2 (N = 446).

	T1		T2	
	N	%	n	%
≤P10	114	25.5	59	13.2
>P10 ≤ P30	94	21.1	61	13.7
>P30	238	53.4	326	73.1

Table 5 Accuracy in TRL at T1 and T2, comparing low and average SES.

	Assessment moments		
	T1 (n = 446)	T2 (n = 446)	t(445)
	Mean (SD)	Mean (SD)	
Average SES	12.80 (9.72)	17.00 (9.84)	-11.18***
Low SES	11.20 (9.73)	15.56 (10.05)	-10.65***

***p < 0.001.

Table 7 Percentage distribution according to the SES (N = 446).

	Average SES				Low SES			
	T1		T2		T1		T2	
	n	%	n	%	n	%	n	%
≤P10	40	20	21	10.5	74	30.1	38	15.5
>P10 ≤ P30	46	23	24	12	48	19.5	37	15
>P30	114	57	155	77.5	124	50.4	171	69.5

Time 2—post-intervention. Table 5 describes the TRL result before and after the intervention. Since the number of students assessed decreased between pre-test and post-test, from this section forward, we will focus exclusively on the results of the 446 students, evaluated in both assessment moments, and, cumulatively enrolled in all sessions of the intervention. In the pre-intervention, the accuracy in the TRL ranged between 11 and 13 (respectively, low SES and average SES). After the intervention, there was a statistically significant increase, both in average SES $t(445) = 17.00$ $p < 0.001$ and in low SES $t(445) = 15.56$ $p < 0.001$. Post-test indicates the absence of statistical differences between average and low SES $t(444) = 1.52$ $p = 0.13$.

The distribution on the TRL by percentile intervals at T1 and T2 is described in Table 6. Concerning reading skills at or below P10, there was a decrease of more than 10% (from 26% to 13%, respectively at T1 and T2). There was an increase of 20% for results higher than the P30 (from 53.4% to 73.1%, respectively).

Table 7 describes the percentile distribution by low and average SES after the intervention. We verify a decrease in the percentage of students with reading skills at or below P10 between T1 and T2 for both low and average SES children. In the same way, the percentage of children with results above the P30 increased between T1 and T2, both in low and on average SES. In the post-intervention, there was no statistical difference between low and average SES $t(444) = 1.52$ $p = 0.13$.

Discussion

This study aimed to diagnose the reading skills of second graders at the beginning of the school year after the major lockdown in schools in consequence of the Pandemic, as well as to assess the impact of a reading intervention program—RSCP—with the same group of children. Both the first assessment and the onset of the intervention took place in September 2021, after an entire final trimester in first grade with a learning scenario drastically

changed, as the schools were closed and online teaching took place (instead of face to face). RSCP was developed to contribute to a national effort to diminish the negative consequences of the extended school closing, specifically developed for promoting alphabetic and orthographic decoding.

At the beginning of first grade, the average accuracy in the TRL was 12.3 (SD = 10), in line with the reference results expected at the end of first grade ($M = 11$; $DP = 6.2$, Silva et al., 2020). A closer look at the results, specifically analyzing the distribution of children across the different reading percentiles, reveals a worrying fact: 45% of the second graders started the school year (pre-test) with results under the P30. More dramatically, over one fourth presented a reading level at or below the 10th percentile.

An inspection of the results according to SES reveals that in the pre-test average SES children had significantly better accuracy compared with low SES children. This result is in line with Portuguese data that reports low SES students are in general characterized as having more reading difficulties and worse reading competencies than their average SES peers (DGE, 2021; CIES and ISCTE, 2011). These results might suggest that children with disadvantaged backgrounds (TEIP type of schools) have probably received less academic support from their parents and were less likely to have access to necessary physical resources (e.g., computer or tablet) during the lockdown (Andrew et al., 2020; Bol, 2020). In Portugal, some families from disadvantaged backgrounds received physical resources from the Portuguese Education Ministry (Machado et al., 2021) such as computers or tablets in order to help their children in attending online classes. However, some families did not know how to use those resources or did not have the availability to support children with simple chores such as turning on the computer and accessing the class. These results confirm that the pandemic increased the inequality in students' reading skills (Bol, 2020), in line with previous research documenting that during long periods of school

interruption such as summer vacations, low SES children had a slower rate of reading ability gain compared to children from high socioeconomic background families (Cooper et al., 1996). Results obtained at the beginning of the school year confirm that the Pandemic increased the tendency for a correlation between academic achievement and SES (Bacher-Hicks et al., 2020; Chetty et al., 2020; Kuhfeld et al., 2021), with the children from lower SES having worse academic achievement.

After the intervention (post-test), reading skills significantly increased for all children. Whereas at the pre-test, 46% of the children had reading skills below P30, at the post-test this percentage decreased to 27%. In addition, after the intervention, there were no statistically significant differences between children according to SES. These results are promising once a specific type of reading intervention during the first 5-week period of the second grade seems able to mitigate the effects of the school closures from the previous trimester, particularly when it comes to the factor of SES.

It was alarming to confirm that children from disadvantaged backgrounds were exactly the ones in worse conditions to overcome these difficulties, as indicated by the pre-intervention assessment. On the other hand, results indicate that an early, systematic and intensive intervention focusing on promoting decoding had a positive impact on reading skills in a short time. The authors expect that this program will be adopted on the early intervention for reading acquisition, thus contributing to promoting confident learners, willing to be fluent readers.

In the present study, concerning the urgency of the pandemic situation, it was the authors' option not to select any children for a non-intervention condition. In future studies, it is important to compare the reading skills between at-risk children subject and non-subject to the RSCP. We hope to have contributed to the first of many studies developing and accessing reading promotion intensive programs, based on scientifically informed strategies. Future studies should also analyze the relationship between parents' involvement during the lockdown, as well as the number of technological equipment's available.

Conclusion

At the beginning of the second grade, after a most atypical first grade affected by the sanitary measures to face the Pandemic, with schools closed for the entire last trimester, an alarming result regarding reading skills was found: over one fourth had poor reading skills, with children from low SES family background significantly more affected. As a response to these results, the authors of this paper develop an intervention program to promote decoding skills during the initial 5 weeks of the school period defined by the Portuguese Ministry of Education as a period of consolidation.

The 5 weeks intervention was very positive, resulting in a significant improvement in reading skills, with an increase of 20 percentual points (53 to 23%) regarding reading abilities above P30 and a decrease of more than 10 percentual points at or below P10 (from 26 to 13%). Also, the 5 weeks intervention resulted in inequality across SES. Our results highlight the need for educators and policymakers to address additional difficulties, where early intervention should take place with those children affected by the pandemic. Educators and policymakers will need to find ways for mass assessment. During the next school year, educators will need to adopt effective strategies to work with those most affected by the school closures. As for decoding, RSCP may be adopted as a complementary strategy, along with those adopted in the regular classroom syllabus. We expect to contribute to the growing important publication trend that empowers school leaders, policymakers, and researchers on their quest for urgent evidence-informed post-COVID-19 recovery decisions.

Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Note

1 The NTEIP/TEIP program is a Portuguese government initiative, currently implemented in schools located in economically and socially disadvantaged territories, marked by poverty and social exclusion, where violence, indiscipline, abandonment and school failure are most evident (TEIP schools). The main goal of the program is to prevent and to reduce early school dropout and the indiscipline (DGE, 2021; CIES and ISCTE, 2011) and improving school grades of the students in the TEIP schools. This is a positive discrimination program aimed at supporting schools located in socioeconomically disadvantaged areas. The strategy of the TEIP program is based on a decentralizing model, focusing on the territory, with the school as a central element in supporting the resolution of community problems (CIES and ISCTE, 2011).

References

- Abuhammad S (2020) Barriers to distance learning during the COVID-19 outbreak: a qualitative review from parents' perspective. *Heliyon* 6(05482):1–5. <https://doi.org/10.1016/j.heliyon.2020.e05482>
- Andrew A, Cattán S, Costa-Dias M, Farquharson C, Kraftman L, Krutikova S, Sevilla A (2020) Learning during the lockdown: Real-time data on children's experiences during home learning. IFS briefing note BN288, London
- Azubuikwe OB, Adegboye O, Quadri H (2021) Who gets to learn in a pandemic? Exploring the digital divide in remote learning during the COVID-19 pandemic in Nigeria. *Int J Educ Res Open* 2(100022):1–10. <https://doi.org/10.1016/j.ijedro.2020.100022>
- Bacher-Hicks A, Goodman J, Mulhern C (2020) Inequality in household adaptation to schooling shocks: COVID-induced online learning engagement in real time. *National Bureau of Economic Research*, 27555, 1–35. <http://www.nber.org/papers/w27555>
- Bao X, Qu H, Zhang R, Hogan T (2020) Modeling reading ability gain in kindergarten children during COVID-19 school closures. *Int J Environ Res Public Health* 17(6371):1–12. <https://doi.org/10.3390/ijerph17176371>
- Bol T (2020) Inequality in homeschooling during the Corona crisis in the Netherlands. First results from the LISS Panel. <https://doi.org/10.31235/osf.io/hf32q>
- Centro de Investigação e Estudos de Sociologia (CIES) & Instituto Universitário de Lisboa (ISCTE) (2011) Efeitos TEIP: Avaliação de impactos escolares e sociais em sete territórios educativos de intervenção prioritária. Retrieved from: https://www.dge.mec.pt/sites/default/files/EPiPSE/estudoteip_sintese.pdf (accessed on 23 Mar 2021)
- Chetty R, Friedman JN, Hendren N, Stepner M, The Opportunity Insights Team (2020) The economic impacts of COVID-19: Evidence from a new public database built using private sector data. *National Bureau of Economic Research*, 27431:1–109. <https://doi.org/10.3386/w27431>
- Cooper H, Nye B, Charlton K, Lindsay J, Greathouse S (1996) The effects of summer vacation on achievement test scores: A narrative and meta-analytic review. *Review of Educational Research*, 3:227–268. <https://doi.org/10.3102/00346543066003227>
- Daniel SJ (2020) Education and the COVID-19 pandemic. *Prospects* 1:1–6
- Direção Geral da Educação – DGE (2015) Metas curriculares de Português: Ensino básico 1.º Ciclo. Retrieved 06 outubro, 2021, from https://www.dge.mec.pt/sites/default/files/Basico/Metas/Portugues/1_ciclo_leitura_escrita.pdf
- Direção-Geral da Educação (DGE) (2021) Linhas orientadoras para elaboração do PPM 2018-2021. Retrieved from: <http://www.dge.mec.pt/documentos-de-referencia-1>
- Dong C, Cao S, Li H (2020) Young children's online learning during COVID-19 pandemic: Chinese parents' beliefs and attitudes. *Children and Youth Services Review*, 118(105440):2–10. <https://doi.org/10.1016/j.childyouth.2020.105440>
- Hall M, Burns M (2018) Meta-analysis of targeted small-group reading interventions. *J School Psychol* 66(1):54–66. <https://doi.org/10.1016/j.jsp.2017.11.002>
- Harris EA (2020, April 27) It was just too much: How remote learning is breaking parents. *The New York Times*. Retrieved from: <https://www.nytimes.com/2020/04/27/nyregion/coronavirus-homeschoolingparents.htm> (accessed on 23 Mar 2021)
- Hodges C, Moore S, Lockee B, Trust T, Bond A (2020) The difference between emergency remote teaching and online learning. Retrieved from: <https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning> (accessed on 23 Mar 2021)
- Jæger MM, Blaabæk EH (2020) Inequality in learning opportunities during Covid-19: Evidence from library takeout. *Res Soc Strat Mobil* 68:100524. <https://doi.org/10.1016/j.rssm.2020.100524>

- Jamshidifarsani H, Garbaya S, Lim T, Blazevic P, Ritchie J (2019) Technology-based reading intervention programs for elementary grades: An analytical review. *Comput Educ* 128(1):427–451. <https://doi.org/10.1016/j.compedu.2018.10.003>
- Kuhfeld M, Soland J, Tarasawa B, Johnson A, Ruzek E, Liu J (2021) Projecting the potential impact of COVID-19 school closures on academic achievement. *Educ Res* 49(8):549–565. <https://doi.org/10.3102/0013189X20965918>
- Lake R, Dusseault B (2020a, April 27) Remote classes are in session for more school districts, but attendance plans are still absent. Center for Reinventing Public Education. Retrieved from: <https://www.crpe.org/thelens/remote-classes-are-session-more-school-districts-attendance-plans-are-still-absent>
- Lyytinen H (2008) New Technologies and interventions for learning difficulties: Dyslexia in Finnish as a case study. In: Foresight Mental Capital and Well-being Project: The Government Office for Science. Government Office for Science, London, UK
- Lyytinen H, Erskine J (2016) Early identification and prevention of reading problems. *Encyclopedia on Early Childhood Development*, 1–5. Retrieved from <http://www.childencyclopedia.com/documents/Lyytinen-ErskineANGxp.pdf>
- Machado F, Alves C, Arantes A (2021) Ensino a distância e digitalização nas escolas durante a pandemia: Uma resposta rápida adaptada à pandemia, mas limitada pela insuficiência de competências e meios digitais a requerer investimentos. [Online learning and digitalization in schools during the Pandemic: A quick and adapted response to the pandemic, but limited by the insufficiency of digital skills and means requiring investments. *Tribunal de contas [Audit Office]* 9(2):1–66. <https://www.tcontas.pt/pt-pt/ProdutosTC/Relatorios/RelatoriosAuditoria/Documents/2021/rel009-2021-2s.pdf>
- Raspin S, Smallwood R, Hatfield S, Boesley L (2019) Exploring the use of the ARROW literacy intervention for looked after children in a UK local authority. *Educ Psychol Pract* 35(4):1–13. <https://doi.org/10.1080/02667363.2019.1632172>
- Reich J, Buttner CJ, Fang A, Hillaire GE, Hirsch K, Larke L, Littenberg-Tobias J, Moussapour RM, Napier A, Thompson M (2020) Remote learning guidance from state education agencies during the COVID-19 pandemic: A first look. Retrieved from: <https://edrxiv.org/437e2> (accessed on 23 Mar 2021)
- Reimer D, Smith E, Andersen IG, Sortkaer B (2021) What happens when schools shut down? Investigating inequality in students' reading behavior during Covid-19 in Denmark. *Res Soc Stratif Mobil* 71(100568):1–5. <https://doi.org/10.1016/j.rssm.2020.100568>
- Silva AF, Marques C, Sucena A (2020) Validity Evidence of the Reading Screening Test for Portuguese First Graders. *Frontiers in Education*, 5(570639):1–7. <https://doi.org/10.3389/feduc.2020.570639>
- Solheim O, Frijters J, Lundstrae K, Uppstad P (2018) Effectiveness of an early reading intervention in a semi-transparent orthography: A group randomised controlled trial. *Learn Instruct* 58(1):65–79. <https://doi.org/10.1016/j.learninstruc.2018.05.004>
- Viner RM, Russell SJ, Croker H, Packer J, Ward J, Stansfield C, Mytton O, Bonell C, Booy R (2020) School closure and management practices during coronavirus outbreaks including COVID-19: A rapid systematic review.

Lancet Child Adolesc Health 4:397–404. [https://doi.org/10.1016/S2352-4642\(20\)30095-X](https://doi.org/10.1016/S2352-4642(20)30095-X)

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Competing interests

The authors declare no competing interests.

Ethics approval

Ethical approval was not required for the study in accordance with institutional requirements. Previous authorizations by the Portuguese Education Ministry were provided.

Informed consent

Informed consent was obtained from all participants and their legal guardians.

Additional information

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