sciendo

Research on Education and Media
Vol. 14, N. 2, Year 2022
ISSN: 2037-0830 – DOI: 10.2478/rem-2022-0022

Impact of the Covid-19 pandemic on students' spelling ability

Nathalie Rzepka[a], Katharina Simbeck[b], Hans-Georg Müller[c]

[a]HTW Berlin, Germany, nathalie.rzepka@htw-berlin.de[b]HTW Berlin, Germany, katharina.simbeck@htw-berlin.de
[c]Universität Potsdam, Germany, hans-georg.mueller@uni-potsdam.de

Abstract

In order to cope with the Covid-19 pandemic, many schools have been closed for several months as of March 2020 in Germany. The unplanned and rapid shift to distance learning formats has led to fears that extensive learning deficits will be created and educational inequality will be further exacerbated. This paper, therefore, investigates the impact of the Covid-19 pandemic on spelling skills (capitalisation, sounds and letters, separate and compound spelling and punctuation) of students in German-speaking countries. For this purpose, we use granular learning process data from an online learning platform for spelling competences with over 1 million solved exercise sets. We compare successful completion of exercise sets before the pandemic and after the first wave of the pandemic and estimate personal competence by a Rasch model. The result shows a loss of competence in 2020 and an increase in inequality in some grade levels and spelling domains. A linear model cannot confirm an overarching loss of competence.

Keywords: *Spelling, Distance Education, Language Skills, Competence*

Introduction

The Covid-19 pandemic has changed the education landscape and posed far-reaching challenges for school education, in particular. Since March 2020, schools in Germany were repeatedly closed for extended periods of time and the course material was taught in distance learning formats. Distance learning had to be implemented very quickly by schools and teachers and was implemented in different ways. Some students did not attend classes at all or for a while because either online classes were not offered or home conditions did not allow them or support for self-motivation was lacking. The impact of the school closures on the students is discussed from different perspectives. In addition to the increased burden on parents, teachers and students and the lack of social contacts, the achievement of learning goals is also questioned. It is feared that the situation has a negative impact on educational success and that learning deficits have arisen (Anger & Plünnecke, 2020; Maldonado & Witte, 2021; Wößmann, 2020).

According to several studies, mastering German spelling is important not only for success at school, but also for people's working and everyday lives (Varnhagen, 2000). For example, studies by Nimz and Möhlmann showed that spelling errors in job applications have a negative impact on job searches (Nimz & Möhlmann, 2021). This paper, therefore, investigates the impact of the Covid-19 pandemic on the spelling competence of students in Germany. In doing so, we examine the research question of whether spelling proficiency has changed as a result of school closures and associated distance learning formats.

1. Related Work

1.1 Situation of school education during the Covid-19 pandemic

As a measure to contain the Covid-19 pandemic, schools in Germany were closed from 15 March 2020. First openings already took place from the end of April, but only with reduced hours or for certain classes. A return to regular classes took place in the federal states between the beginning and middle of August 2020.

According to Anger and Plünnecke (2020), various factors play a role in describing the effects of school closures on learning success. On the one hand, the amount of time spent per day on school activities is an indicator of how much students learn at home. In a survey of more than 1,000 parents of school children, Wößmann et al. (2020) showed that the amount of time students spent on school activities dropped sharply during the school closures. Before the pandemic, an average of 7.4 h per day was spent on school activities, whereas during the school closures, the average was only 3.6 h. Thirty-eight per cent of school children were even engaged in school activities for less than 2 h per day.

Parental support and the learning environment at home form another factor influencing the impact of the pandemic on students. Huebener et al. (2020) found that the learning environment and school motivation of higher and lower performing students differ significantly, thus reinforcing educational inequality. An analysis of the Socio Economic Panel (SOEP) data also revealed that children from lower-educated backgrounds are less well equipped with computers or laptops than children from academic families (Anger & Geis-Thöne, 2018).

Regarding the quality of homeschooling, some studies show that the rapid and short-term conversion to distance learning formats was inadequately implemented in many cases (Thies & Klein, 2020; Wildemann & Hosenfeld, 2020; Wößmann, 2020). According to Wößmann (2020), for a considerable part of the students, learning is completely cancelled during school closures.

Comprehensive studies from German-speaking countries on the loss of competences due to school closures are not yet available. However, a study from Belgium already shows significant learning losses among primary school children. Standardised achievement tests showed a decline of 0.19 points standard deviation in mathematics and 0.29 points in Dutch (Maldonado & Witte, 2021). Kuhfeld and Tarasawa (2020) used a different approach, transferring the effects of the so-called 'summer gap' (long summer holidays in the USA and Canada) in projection models to the school closures by Covid-19. They showed strong drops in mathematics. Di Pietro et al. (2020) calculated from given studies on reduced learning time that a loss of 0.8%–2.3% of learning performance per week can be expected due to the school closures.

1.2 Rasch modelling to determine personal ability

The Rasch model is one of the many Item Response Theory (IRT) models for analysing tests, surveys or ratings (Khine, 2020). It is often used in educational research, psychological testing or rehabilitation to analyse psychometric data or to guide development, improve, validate and calibrate surveys, questionnaires, ratings or tests (Bond, 2010; Khine, 2020). There are two main reasons to conduct a Rasch modelling to determine personal abilities: first, Rasch model takes into account the item difficulty. By using raw scores to analyse tests or rating, one would ignore item difficulty or different extents of agreeability in ratings. A Rasch model, on the other hand, considers item difficulty as well as agreeability of ratings (Boone, 2020). Secondly, if used to analyse ratings, Rasch model makes no assumptions about the spacing between rating scale categories (Boone, 2020). The model thus does not require the rating scale to be linear, as long as it is ordinal (Boone, 2020).

Regardless of the test, questionnaire or rating, the measures are expressed on the same scale (Khine, 2020). Furthermore, the item difficulty and a personal ability are both estimated along the logs odds unit scale (logit) (Bond, 2010). The sufficient statistic for the Rasch model is the total score of persons who correctly answered the item (for item difficulty) and the total score of items which are correctly answered by a person (for personal ability) (Bond, 2010).

The Rasch model for dichotomously scored responses is defined by

$$\ln\left(\frac{P_{ni}}{1-P_{ni}}\right) = B_n - D_i$$

where is the personal ability and is the item difficulty (Boone, 2020). The probability of a correct item is modelled as a logistic function of the difference in the personal ability and item difficulty. is the probability of respondent getting the item correct. Consequently, is the probability of a respondent not getting the item correct. Accordingly, for two persons with different abilities answering the same item , the difference between and is higher for the person with higher ability, thus resulting in a higher probability of solving the item correctly. Thus, the probability of a correct answer always corresponds to the task difficulty and personal ability.

2. Data set and method

The online platform orthografietrainer.net is a resource for the acquisition of spelling skills for students from the fifth grade onwards. It offers exercises in different formats for all important areas of German spelling. These include capitalisation, sounds and letters, separate and compound spelling and punctuation. The exercises can be completed in free practice, in a specific orthographic subarea or as part of competence tests. These offer the possibility to classify one's own spelling ability in order to continue with tasks at the appropriate level of difficulty. Teachers can register their classes and assign tasks to the students to do in class or as homework. The platform offers over 5,000 assignments that have already been completed by over 900,000 users.

In this paper, we compare November and December of 2019 and 2020 to examine the effect of school closures in spring/summer 2020. While in 2019, coronavirus was not yet a factor in the European region, by the end of 2020, students had already experienced up to 5 months of partial school closures and distance learning. Data are available from grades 1 to 13. Our analyses focus on grades 5–10. The reason is that in these grades, spelling is an integral part of German lessons, whereas in the higher grades, this knowledge is a prerequisite. Consequently, in classes up to 10, teachers mostly register the class as a whole, while students from class 10 onwards do their assignments individually, for example, because they have special issues with spelling.

After data set filtering, we are left with 15,579 users who completed a total of 1,013,417 exercises. Figure 1 shows the distribution of exercises by year and orthographic domain. It can be seen that almost twice as many tasks were solved in 2020 as in 2019. The number of tasks per domain also differed greatly. The tasks for sounds and letters (SL) were completed the most, with over 500,000 sets solved. This is followed by the domain capitalisation (C). The least number of tasks were solved by punctuation (P) and separate and compound spelling (SC), each of which showed around 200,000 solved tasks.

Subsequently, different preprocessing steps were conducted, including one-hot encoding of categorical variables and splitting the data according to the orthographic domain. For each of the orthographic domains, the abilities of the individuals were estimated by implementing a dichotomous Rasch model. Our raw scores for correct and incorrect responses are 0 (=incorrect) and 1 (=correct). Consequently, the higher the result score in logits unit, the higher is the estimated personal ability or item difficulty.

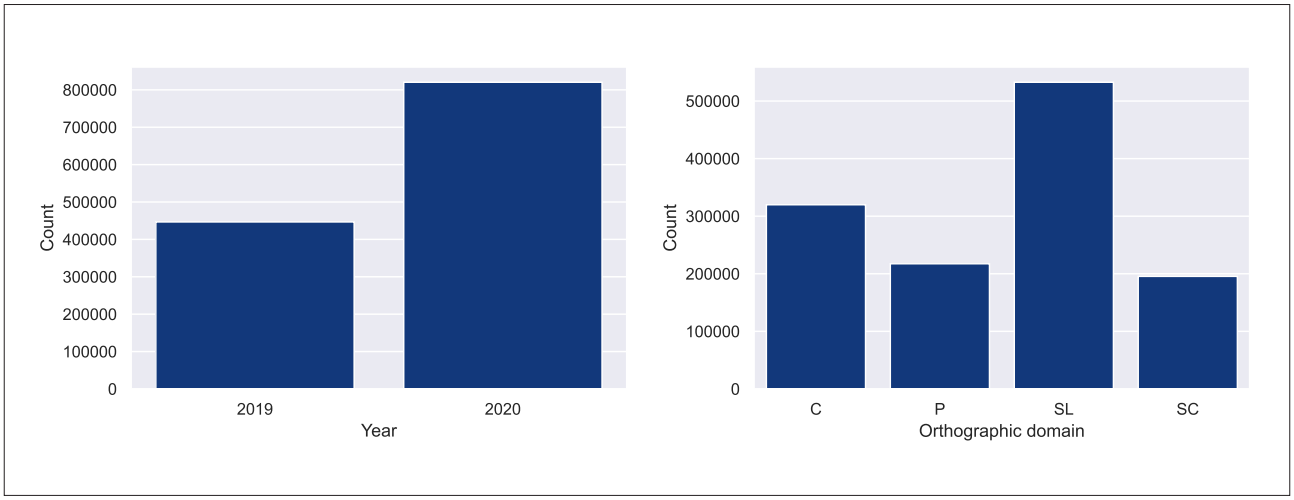


Fig. 1: Count of exercises per year and orthographic domain (C = capitalisation, P = punctuation, SL = sounds and letters and SC = separated and compound spelling)

3. Results

Overall, the impact of school closures varies. The results show that abilities in some grades will deteriorate in 2020. However, a linear model cannot confirm an overarching effect. Educational inequality measured by the standard deviation increases in three out of four spelling domains.

3.1 Rasch scaling

The Rasch scaling of the estimated personal ability shows a range from -4.84 to +5.98 logits. The competences differ strongly according to spelling area. Abilities in punctuation and capitalisation are lower than those in separate and compound spelling. The competences of the spelling area sounds and letters are the highest.

Furthermore, when looking at the practice tasks of 2019, it can be seen that the abilities increased by 0.27 logits on average with each grade level. Equivalent to the abilities per spelling area, they increased less quickly in punctuation and capitalisation than the abilities in separate and compound spelling as well as in the area of sounds and letters. Figure 2 shows an example of the increase in ability with increasing grade level in capitalisation.

3.2 Development of abilities

Comparison of the figures from winter 2019 and those in 2020 show significant differences in proficiency levels in many classes and in most spelling areas.

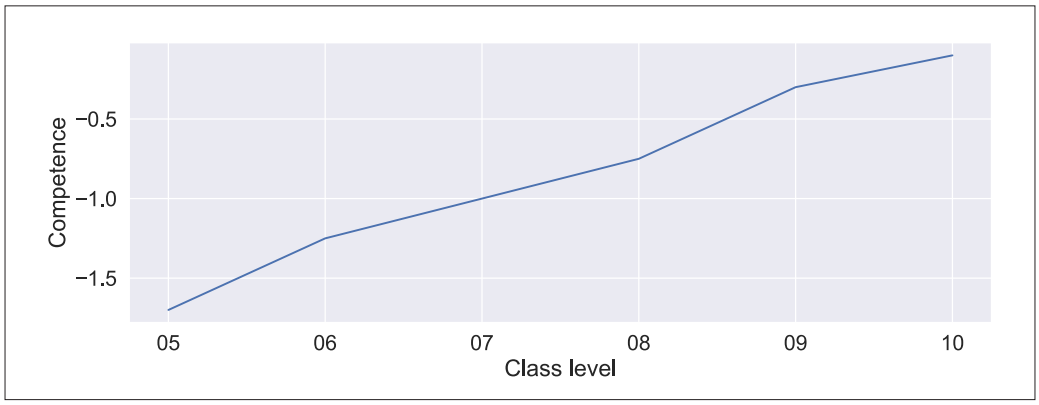


Fig. 2: Average ability in logits with increasing class level in capitalisation exercises

Table 1: Differences between the average ability in 2019 and 2020 per orthographic domain and class level in logits
P = punctuation, SL = sounds and letters, SC = separate and compound Spelling, C = capitalisation

Class level	P	SL	SC	C
5	-0.11	-0.03	0.15	0.20
6	-0.13	0.01	-0.10	0.10
7	0.12	-0.08	0.01	-0.02
8	-0.16	-0.26	-0.17	-0.07
9	-0.19	0.07	-0.14	-0.03
10	-0.14	-0.12	-0.13	-0.24

Table 1 shows the differences for each spelling domain. The competencies in punctuation decreased in every grade except grade 7 by 0.11–0.19 logits. There are further deficits in the area of capitalisation, where the majority of the competences have also decreased. There is less of a deterioration in the areas of separate and compound spelling and sounds and letters. There is a slight loss of ability in separate and compound spelling in grades 7 and above, but even an improvement in grades 5 and 6. In the case of sounds and letters, there are clear competence deficits in grades 7, 8 and 10, but the ability increases in other grades.

Table 2 shows the results of linear regression. In the coefficients, the increase in competence by grade level can be seen. Furthermore, gender is significant in all spelling domains, as are grades 7–10 and the school types high school and secondary school with final grades 9/10. The year does not show substantial development in any orthographic domain.

Table 2: Linear model with $*P < 0.05$

Feature	Punctuation (R2 = 12.8)		Sounds and letters (R2 = 25.7)		Capitalisation (R2 = 21.2)		Separate and compound spelling (R2 = 18.5)	
	Coeff.	$P > \|t\|$	Coeff.	$P > \|t\|$	Coeff.	$P > \|t\|$	Coeff.	$P > \|t\|$
Const	-2.7219	0.0000*	0.2566	0.0000*	-2.7452	0.0000*	-0.0164	0.8280
Gender	0.2699	0.0000*	0.2496	0.0000*	0.2226	0.0000*	0.1764	0.0000*
Year_2020	0.0176	0.8070	0.0293	0.5100	-0.0369	0.4540	0.0440	0.3410
Classlevel_06	0.1831	0.1990	0.4709	0.0000*	0.4060	0.0000*	0.1460	0.0340*
Classlevel_07	0.7519	0.0000*	0.8105	0.0000*	0.8627	0.0000*	0.3991	0.0000*
Classlevel_08	0.9707	0.0000*	1.1197	0.0000*	1.0960	0.0000*	0.4078	0.0000*
Classlevel_09	1.3173	0.0000*	1.3025	0.0000*	1.5583	0.0000*	0.8038	0.0000*
Classlevel_10	1.4016	0.0000*	1.5671	0.0000*	1.7144	0.0000*	0.9854	0.0000*
Schooltype_Fachoberschule	-0.0819	0.8740						
Schooltype_Gymnasium	1.0437	0.0000*	0.9023	0.0000*	1.2169	0.0000*	0.9107	0.0000*
Schooltype_Realschule	0.1154	0.2790	0.0866	0.1900	0.3493	0.0000*	0.2370	0.0020*
Schooltype_Hauptschule					0.0752	0.5100	-0.1240	0.2690
Schooltype_Sekundar12/13	0.1825	0.1300	0.1576	0.0260*	0.4721	0.0000*	0.2701	0.0010*
Schooltype_Sekundar9/10	0.3425	0.0000*	0.1814	0.0030*	0.3112	0.0000*	0.3183	0.0000*
Gender × Year_2020	-0.0962	0.3320	-0.0504	0.4130	-0.0003	0.9970	0.0114	0.8590

School types in German school system: Fachoberschule = technical secondary school; Gymnasium, Realschule, Hauptschule = separated secondary school levels 1–3; Sekundar12/13, Sekundar9/10 = mixed secondary school with final grades 12/13 or 9/10

3.3 Educational inequality

In addition to looking at the changes in ability overall, there are concerns that educational inequality has increased as a result of school closures. We measure this with the help of the standard deviation, which indicates the dispersion of the estimated mean competence. If the dispersion is higher in 2020 than in 2019, then educational inequality has increased.

As can be seen in Figure 3, the standard deviations in the spelling domains of punctuation, capitalisation and separate and compound spelling are higher in most grades in 2020. The difference in standard deviations between the two time periods is highest in the area of punctuation, at 0.06 logits. A difference of 0.05 logits for the area of capitalisation and 0.03 logits for the area of separate and compound spelling also shows an increase in the standard deviation, and thus an increasing educational inequality. Only in the area of sounds and letters, we do not observe this effect.

4. Discussion and Outlook

We have implemented a Rasch model to compare the ability of students in German orthography in November and December 2019 (pre-school closures during the Covid-19 pandemic) and 2020 (after the first wave of the Covid-19 pandemic) using a data set with more than 1 million completed exercises. Our analysis yielded two interesting results. On the one hand, we found, contrary to our expectations, no significant decline, but stable orthographic competencies after school closures. On the other hand, we did find an increase in variance of educational competencies.

Even though we found competence losses in many grade levels and orthographic domains, the linear model shows that there is no overarching effect and the year does not confirm any significant changes. A closer look at the differences in competencies reveals interesting insights between grades and spelling domains. Although the majority of the competencies have worsened, there are also grades and areas in which the competence has actually improved (e.g. punctuation in class level 7 or capitalisation in class level 5). Since both school grades in the German school system are typical for transitions to another school type, the positive effects could have been caused by a higher motivation of the students. The tendency towards higher engagement at a new school may have partially offset the negative effects of the pandemic situation here.

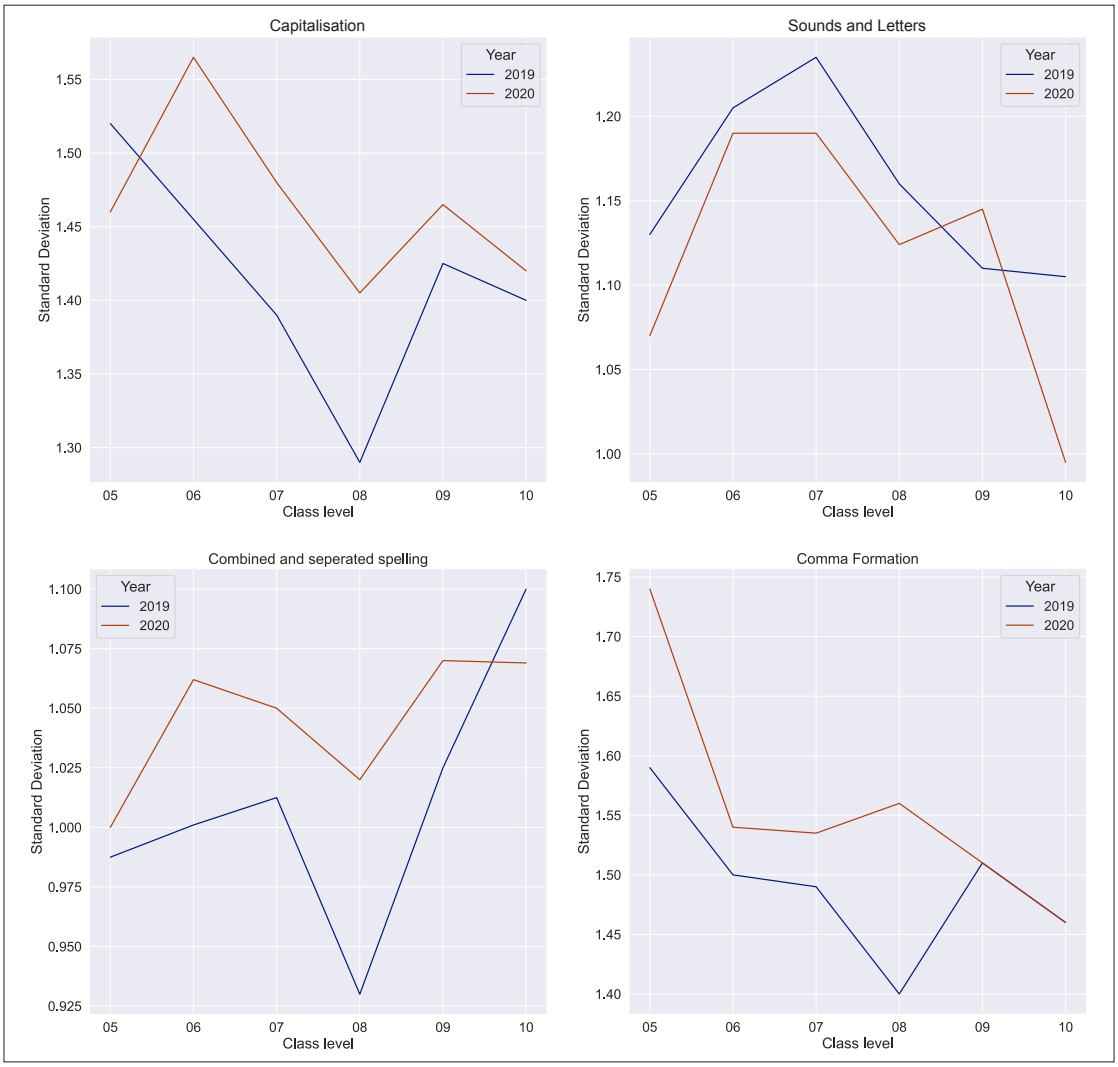


Fig. 3: Standard deviation by class level and orthographic domain

In addition, the lack of negative effect from several week long school closures on measured competence can be explained by a selection bias in our data set. The use of the training platform immensely increased during the pandemic. Teachers had to find quick online alternatives – tasks like those found on Orthografietrainer.net could, therefore, be a great relief for teachers. Thus, more spelling tasks may have been carried out than usual, because other components of German lessons, for example, book discussions or essay writing, are much more difficult to transfer into online formats.

Another reason for little deterioration or improvement may also be that teachers selected students practising on the learning platform differently. For example, teachers in 2019 may have sent weaker students, in particular, to the platform to provide supplementary practice alongside actual classroom instruction. This internal differentiation was implemented less during the pandemic; teachers assigned the same tasks to whole classes, and thus, good students also achieved good results.

Lastly, the selection bias also reflects social and demographic realities. Students with the biggest loss in instruction and learning time might be least represented on the platform due to lack of computer access or parental encouragement. Schools in Germany are differently equipped and digitised to varying degrees depending on the region and type of school. Furthermore, there are differences in the commitment of the teacher, school and district, as well as in the Covid-19 policy of different federal states. The situation of the students at home also differs: the learning environment, access to computers, support from parents, etc. All these parameters are crucial for the development of abilities and cannot be taken into account by the data on the online platform orthografietrainer.net. In addition, there are the learning losses of children and adolescents for whom access to school education has been completely eliminated due to the circumstances of the pandemic, and who are, therefore, not reflected in the data collected (Wößmann, 2020). Therefore, it is important to look not only at the absolute average differences, but also at educational inequality.

We measured educational inequality in standard deviations of the competence. We found that standard deviations of competence levels have notably increased, which shows that educational inequality has increased in three of four orthographic domains. The increased variance within the competence variable indicates that the pandemic situation affected the test population differently. While potentially high-performing students may have benefited from the additional spelling training, the difficulties of lower-performing students tended to deepen during the pandemic. The above-mentioned large differences in the children's real learning situations are reflected here again. While some children were provided with a good and supportive learning environment at home, others were left on their own and had little support. Furthermore, some children have even benefitted from homeschooling, better motivation and support at home and the absence of distractions in the classroom.

Our results thus show that for those children for whom school-guided learning at home with adequate digital tools did take place, no loss in competence can be found on average. However, educational inequality has increased due to Covid-19, as expressed in bigger standard deviations. Further research is urgently needed to assess the outcome of school closures for children who could not benefit from school-guided learning at home with adequate digital tools and of the second wave of school closures in winter 2020/2021. The data from this natural experiment also showed that some children seem to benefit from a supposedly supportive homeschooling environment and digital learning tools.

4.1 Outlook

As described above, in the next step, further factors should be included in the investigation in order to examine regional and school-specific differences. Furthermore, family conditions could also be asked for within the framework of a survey on the platform in order to conduct differentiated investigations.

Despite the heavy burden on all those affected, school closures in the first wave of the Covid-19 pandemic were temporary. Thus, by August 2020, most schools had resumed regular operations, and many had already reopened for individual classes by the end of April. As new school closures were decided from December 2020 onwards, data from autumn 2021 will allow even more comprehensive conclusions to be drawn about the impact of school closures on students' spelling competence. Spelling is also a skill area that does not change as quickly as others. It would, therefore, also make sense to examine other subjects such as mathematics with regard to competence development.

5. Acknowledgements

This research has been funded by the Federal Ministry of Education and Research of Germany in the framework 'Digitalisierung im Bildungsbereich' (project number 01JD1812A).

References

Anger, C., & Geis-Thöne, W. (2018). Integration von Kindern und Jugendlichen mit Migrationshintergrund: Herausforderungen für das deutsche Bildungssystem. IW-AnalysenUR - https://www.econstor.eu/handle/10419/190957 no. 125, Köln: Institut der deutschen Wirtschaft (IW).

Anger, C., & Plünnecke, A. (2020). Schulische Bildung zu Zeiten der Corona-Krise. *Perspektiven der Wirtschaftspolitik, 21,* (*4*, 353–360).

Bond, T. G. (2010). Rasch Model. In I. B. Weiner, & W. E. Craighead (Eds.), *The Corsini Encyclopedia of Psychology.* Hoboken, NJ, USA: John Wiley & Sons, Inc.

Boone, W. J. (2020). Rasch Basics for the Novice. In *Rasch Measurement* (pp. 9–30). Springer, Singapore. Retrieved from https://link.springer.com/chapter/10.1007/978-981-15-1800-3_2.

Di Pietro, G., Biagi, F., Costa, P., Karpinski, Z., & Mazza, J. (2020). The likely impact of COVID-19 on education: Reflections based on the existing literature and recent international datasets.

Huebener, M., Spieß, C. K., & Zinn, S. (2020). SchülerInnen in Corona-Zeiten: Teils deutliche Unterschiede im Zugang zu Lernmaterial nach Schultypen und -trägern. *DIW Wochenbericht, 87,* Retrieved from https://www.econstor.eu/handle/10419/226771.

Khine, M. S. (Ed.). (2020). *Rasch Measurement*. Singapore: Springer Singapore.

Kuhfield, M., & Tarasawa, B. (2020). The COVID-19 Slide: What Summer Learning Loss Can Tell Us about the Potential Impact of School Closures on Student Academic Achievement. Brief. *NWEA*. Retrieved from https://eric.ed.gov/?id=ed609141.

Maldonado, J. E., & Witte, K. de. (2021). The effect of school closures on standardised student test outcomes. *British Educational Research Journal. doi:*10.1002/berj.3754

Nimz, K., & Möhlmann, H. (2021). Zum Einfluss orthographischer Fehler in Bewerbungsschreiben. Eine experimentelle Untersuchung mit Personalverantwortlichen. In M. Kepser, S. Schallenberger, & H.-G. Müller (Eds.), *Neue Wege des Orthografieerwerbs. Forschung-Vermittlung-Reflexion.* Wien: Lemberger.

Thies, L., & Klein, Y. (2020). *Unter Druck. Die Situation von Eltern und ihren schulpflichtigen Kindern während der Schulschließungen*.

Varnhagen, C. K. (2000). SHOOT THE MESSENGER AND DISREGARD THE MESSAGE? CHILDRENS ATTITUDES TOWARD SPELLING. *Reading Psychology, 21,* (*2*, 115–128). doi:10.1080/02702710050084446

Wildemann, A., & Hosenfeld, I. (2020). *Bundesweite Elternbefragung zu Homeschooling während der Covid 19-Pandemie*.

Wößmann, L. (2020). Folgekosten ausbleibenden Lernens: Was wir über die Corona-bedingten Schulschließungen aus der Forschung lernen können. *ifo Schnelldienst, 73,* (*06*, 38-44UR - Retrieved from https://www.econstor.eu/handle/10419/225139).

Wößmann, L., Freundl, V., Grewenig, E., Lergetporer, P., Werner, K., & Zierow, L. (2020). Bildung in der Coronakrise: Wie haben die Schulkinder die Zeit der Schulschließungen verbracht, und welche Bildungsmaßnahmen befürworten die Deutschen? *ifo Schnelldienst, 73,* (*09*, 25-39UR - Retrieved from https://www.econstor.eu/handle/10419/225170).