Reading and Writing
https://doi.org/10.1007/s11145-023-10502-7

Literacy instruction from afar: evidence for the effectiveness of a remotely delivered language-rich reading programme

Cameron Downing[1,2] · Gwennant Evans-Jones[3] · Simone Lira Calabrich[3] · Caspar Wynne[1] · Rachel Cartin[3] · Joanna Dunton[2] · Ruth Elliott[2] · Markéta Caravolas[2,3] · Charles Hulme[4] · Manon Jones[2,3]

Accepted: 8 December 2023

Abstract

There is good evidence that high-quality instruction targeting reading-related skills in the classroom leads to gains in reading. However, considerably less is known about the possible efficacy of *remote* instruction. This study evaluated the efficacy of an interactive evidence-based language-rich literacy programme. 184 children were randomly allocated either to an 8-week remotely delivered language-rich literacy programme or to a wait-list control group. Children in the programme arm ($n=77$ at analysis) completed 16-lessons remotely targeting vocabulary, phonemic awareness, reading, spelling, and narrative skills. Children in the wait-list arm ($n=58$ at analysis) received business-as-usual from their schools. Children's word reading accuracy and phonemic awareness was measured prior to and after the programme delivery period. Children receiving the literacy programme made significantly larger gains than the wait-list control group on reading accuracy ($d=0.32$) and phonemic awareness ($d=0.63$). This study demonstrates that a remotely-delivered literacy programme is effective. These findings have important implications for delivering specialist literacy instruction at scale.

Keywords Reading · Phonemic awareness · Instruction · Technology

✉ Cameron Downing
c.downing@leedstrinity.ac.uk

[1] School of Psychology, Leeds Trinity University, Leeds, UK

[2] Miles Dyslexia Centre, Bangor University, Bangor, UK

[3] School of Human Behavioural Sciences, Bangor University, Bangor, UK

[4] Department of Education, University of Oxford, Oxford, UK

Published online: 06 January 2024

Introduction

There are now several well-validated and effective school-based literacy interventions and programmes that reliably promote significant gains in children's literacy outcomes (e.g., Bianco, 2010; Bowyer-Crane et al., 2008; Clarke et al., 2010), and which are founded on an empirical understanding of reading development (Duff & Clarke, 2011; Snowling & Hulme, 2011). However, school closures in the wake of Covid-19 – which made normal, classroom education impossible across the world – have raised questions concerning how best to teach core educational skills, such as literacy, by remote delivery. This question is non-trivial, given emerging evidence of how school closures has had an overall detrimental impact on children's reading skills (Tracey et al., 2022). Moreover, children who struggle to acquire literacy are already at risk of poorer educational outcomes (e.g., Rose, 2009; Shaywitz et al., 1999), and the impact of the pandemic in further widening this attainment gap cannot be underestimated (Clark & Picton, 2021; Goldhaber et al., 2022; Kuhfeld et al., 2022). In this study, we tested whether an evidence-based literacy-with-language programme *delivered remotely* can lead to gains in literacy skills which are often delivered in-person.

The simple view of reading argues that decoding and language comprehension skills are necessary for reading comprenehsion (Gough & Tunmer, 1986). A substantial body of evidence shows that classroom interventions training word-level decoding skills, phonemic awareness, and letter knowledge promote significant gains in word-level literacy outcomes amongst early and struggling readers (Hatcher et al., 2006; Ehri, 2011; Hulme et al., 2012). A further substantial body of evidence shows that language comprehension skills such as vocabulary knowledge and narrative skills (e.g., the structuring and sequencing of events; e.g. Bowyer-Crane et al., 2008; Clarke et al., 2010). Such intervention studies have uniformly been conducted within a school setting, involving face-to-face interaction between the teacher and child.

Remote learning, on the other hand, can potentially impoverish the interactivity between learner and instructor, which is a key component in determining the success of educational instruction (Huemer et al., 2008). Remote learning came to prominence during school closures taken to curb the spread of Covid-19. Learning to read and write appears to have been particularly affected by the shift to remote instruction during these school closures. Goldhaber et al. (2022) found in a large American sample that the largest loss in learning to read were present for children who received remote or hybrid instruction. Remote instruction disproportionately affected student attainment in lower income and socioeconomic districts suggesting that engagement, attendance, and growth in learning is attenuated when the instructor and learner are physically separated. This trend is particularly pertinent amongst younger children. A natural experiment conducted during the pandemic, in which children's test performance during an eight-week period in lockdown was compared to a similar window of pre-pandemic education, showed that whilst secondary school-aged children were relatively unaffected by the switch to online learning, primary school-aged children's growth

in language and mathematics skills slowed, and interindividual differences in gains increased (Tomasik et al., 2021). The school closures resulting from the pandemic-related social distancing restrictions have now been relaxed. These closures have brought to the fore the questions concerning the efficacy of remote literacy instruction.

To our knowledge, there has been no rigorous evaluation—in the form of randomized controlled trials–of the efficacy of remotely administered literacy instruction. However, surveys and reviews suggest there are likely to be several reasons as to why remote reading instruction has been observed to be less effective than in-person reading instruction. Child level factors include being less able to self-regulate and fully engage in online learning, particularly in younger children (Dong et al., 2020). Teacher level factors include teacher's limited experience with technology that is necessary for remote instruction. Issues around teacher's limited experience of technology were particularly acute during Covid-19 school closures owing to the rapid move to online delivery (Reimers & Schleicher, 2020). Ensuring the high levels of interactivity necessary for effective language and literacy instruction is difficult to replicate online, particularly with limited experience of technology (McTigue et al., 2020). For literacy instruction specifically, training certain skills such as phonemic awareness is more effective when it is explicitly taught with active engagement and interactivity between the learner and instructor, using definitionally and contextually rich materials (National Reading Panel, 2000; but see also Rice et al., 2022). As such, evidence for the efficacy of high quality remote learning in developing children's literacy skills is currently sparse (cf., Sayko, 2020; Livingstone, 2012).

It is clear that interactivity is an important component for effective literacy teaching and this might be difficult when using remote instruction. Here, we sought to rigorously test the efficacy of a remotely-delivered language-rich literacy instruction programme which utilised digital innovations to maximise interactivity. The programme utilised digital innovations for remote instruction both synchronously (live interaction between the pupil and teacher) and asynchronously (self-motivated study by the child with feedback provided later from a teacher). We delivered a bespoke language-rich literacy programme https://www.rillresearch.org/home) for 8-11-year-old UK children remotely via personal computers. The programme focused on the development of key reading-related skills, based on the simple view of reading (Gough and Tunmer, 1986; e.g., reading and phonemic awareness), using empirically validated instructional techniques (e.g., Bowyer-Crane et al., 2008; Duff et al., 2008). We examined whether children who completed the programme made larger gains than children who only received learning materials from their school in two key word-level literacy skills: word reading accuracy and phonemic awareness.

Method

Participants

Participants were recruited via schools and social media advertising to parents. Recruitment was open to children of all reading abilities in UK school year groups

3–6 (Key Stage 2). Of the 230 children (8–11 years old; $M = 9.66$ years, $SD = 1.52$) assessed for eligibility, 184 entered the trial and were randomly assigned to either receive the programme ($n = 90$) or form part of the wait-list control group ($n = 94$). Moderate attrition rates resulted from families' difficulties with technology and/or scheduling issues due to UK travel and social distancing rules during the Covid pandemic (see Fig. 1). We retained 72 participants in the programme arm and 58 children in the wait-list control arm ($N = 125$). Ethical approval for this study was given by School of Human and Behavioural Sciences Ethics Committee, Bangor University, and this study complied with the British Psychological Society's Code of Ethics and Conduct. In all cases (school and individuals' recruitment), informed

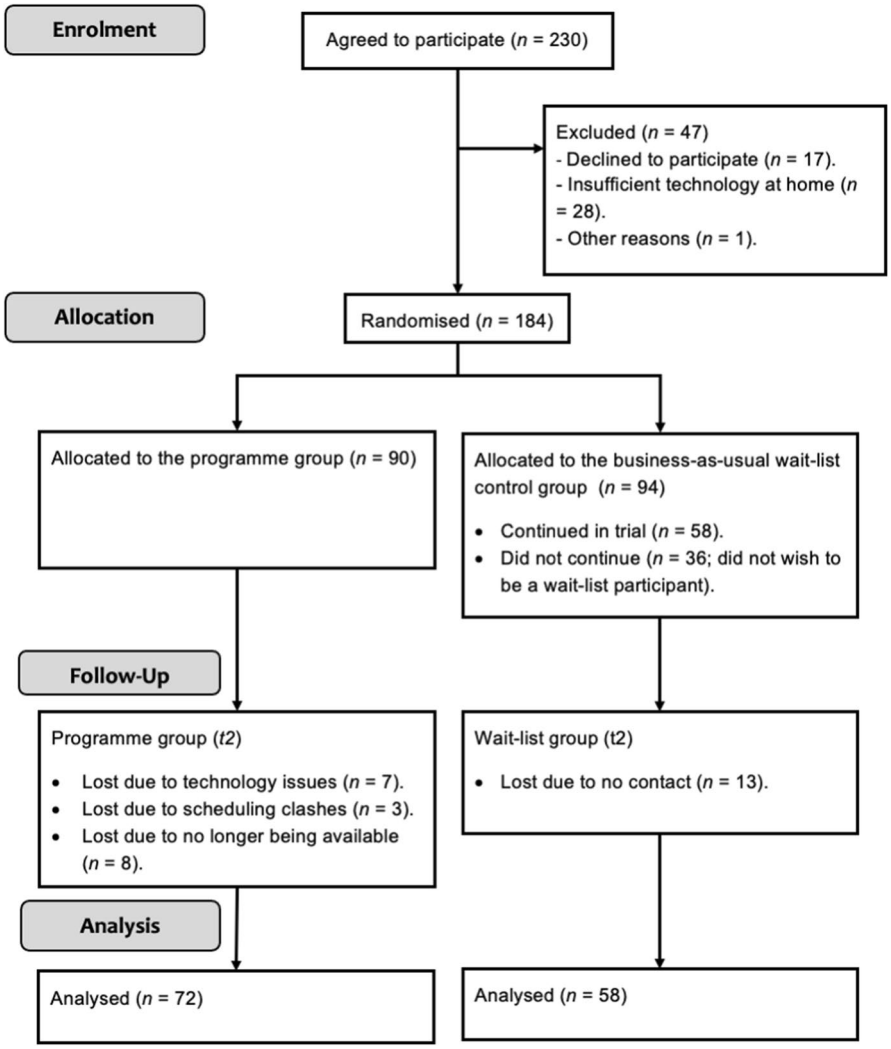

Fig. 1 CONSORT diagram showing the flow of participants through the trial

consent for children's participation was given by a parent or legal guardian. In cases of school participation, consent was given by headteachers, also.

Design

Participants in the programme arm underwent two cycles of teaching. Participants in Group A received the synchronous lessons (live online interaction between pupil and teacher) for first 8-lessons and the asynchronous lessons (self-motivated study by the child with feedback provided later from a teacher) for the latter 8-lessons. Participants in Group B received the asynchronous lessons for the first 8-lessons and the asynchronous lessons for the latter 8-lessons (see Fig. 2). Note that owing to lack of power and likely carry-over effects we do not analyse the separate effects of asynchronous and synchronous teaching compared to the waitlist control. Participants in the wait-list control group completed work set by their school, as usual. The type and frequency of literacy instruction with children in the control group varied by school. However, most children in the control group were completing asynchronous literacy activities on their own. These activities were set by their teacher atleast once a week. We report data prior to delivery of the programme (t1; pretest) and following the programme (t2; posttest).

The language rich reading programme

Each lesson comprised a prescribed set of activities targeting word-level skills, but also broader language skills too. The lesson began with a vocabulary task (approximately 5 min), in which children would learn two new Tier 2 words (see Beck et al., 2002). Following this, children read a passage (approximately 10 min) which included the two vocabulary words as well as a high number of decodable words. Children then completed a phoneme awareness activity (approximately 5 min) where children worked on blending up to five words composed of the same phonemes. Children then worked on spelling (approximately 5 min) focussing on specific, graded spelling patterns with children being taught to segment and examine the orthographic context of specific spelling patterns (see Treiman, 2018). For example, when teaching children to spell words ending in the/v/sound (e.g., 'give'), children are taught to segment the word, identify the final/v/sound and apply their graphotactic knowledge that words in English ending with

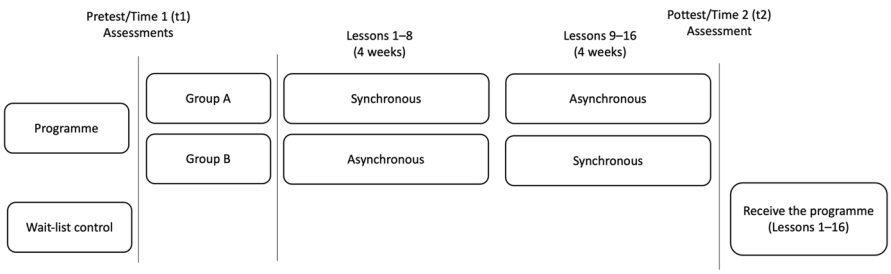

Fig. 2 Timeline of the assessments and programme delivery

the letter 'v' predomintly accompanied with the letter 'e'. Where possible, the words used in the vocabulary or phoneme awareness activities were common to both sets of activities (see Graham et al., 2018). Following this, children completed a narrative section (approximately 10-minutes), which focused on one key narrative skill (e.g., characters, sequencing, and structuring, elaborating, connectives, and verb use; see Clarke et al., 2010) in both verbal and written domains. These skills were used to construct a story over several sessions. Towards the end of the session, children recapped the vocabulary words (approximately 5 min). See Online Resource 1 for a comprehensive overview (example) of a single lesson.

Children completed 16 lessons over 8-weeks. Whilst this programme is shorter than the recommendations of the National Reading Panel (2000), we were constrained by the time children had left in school prior to the summer holidays and shorter interventions have previously shown some promising effects (e.g., Hatcher et al., 2006). We produced two identical versions of the programme lessons. One for synchronous administration and another for asynchronous administration. Children completed each lesson individually. That is either 1:1 with the teacher when completing the lessons synchronously or on their own when completing the lesson asynchronously.

Interactivity is important for ensuring effective instruction but may be difficult to replicate remotely (McTigue et al., 2020). We used digital technology to provide interactivity in both the synchronous and asynchronous lessons. Interactive synchronous instruction included the teacher and child working through the activities together via Microsoft Teams and OneNote. An example of incorporating interactivity synchronously would be the teacher asking the child to create movements related to the meaning of one of the words in the vocabulary task. Interactive asynchronous instruction involved children working through the OneNote session independently of the teacher, but with various iteractive elements. An example of incorporating interactivity asynchronously would be the use of sound clips to provide the pronunciation of the target word followed by GIFs to illustrate the meaning of the word in the vocabulary task.

Procedure and measures

Tests were administered remotely to participants' homes in the presence of a legal guardian over Microsoft Teams, prior to beginning (t1) and after the programme period (t2; see Fig. 2) via Gorilla (Anwyl-Irvine et al., 2020). Most tests were administered live by a trained research assistant. Sessions were recorded on Audacity for transcription purposes. Offline tasks were completed independently by the child and included video and verbal instructions via Gorilla, with capacity for replay. The assessment battery included the following measures.

Non-verbal ability (t1)

Matrices subtest from the Wide Range Intelligence Test battery (Glutting et al., 2000). Participants select an image amongst three to five distractors that satisfies a logical continuation in a series four to six images. The images were presented on the child's screen via screen sharing and gave the number of the answer they believed

was correct. The items increased in difficulty. Administration ended when four non-consecutive errors were made in five items, in accordance with the manual. We followed the published guidelines when scoring.

Word reading accuracy (t1, t2)

WRAT-4 Word Reading subtest (Wilkinson & Robertson, 2006) assesses children's ability to accurately pronounce letters and words of increasing difficulty (i.e., frequent to less frequent words, and transparent to opaque spelling). The items from the WRAT were displayed on the child's screen via screen sharing. The child was asked to say the letter or the words aloud. Discontinuation follows ten consecutive errors. We followed the published guidelines when scoring.

Phonemic awareness (t1, t2)

The MABEL Phoneme Deletion test (Caravolas et al., 2018) assesses children's phonemic awareness. Children repeat a pseudoword after removing either the initial (10 items, onsets) or final (10 items, codas) phoneme. Accuracy and speed are measured. We focused particularly on speed.

Results

Analysis plan

We assessed whether a short (8-week) remotely delivered literacy with language programme would lead to gains in reading and phoneme awareness. The primary outcome measure is reading accuracy administered individually at pre- and post-test. The secondary outcome measure is phoneme awareness, also administered individually at pre- and post-test.

The analyses were performed on an intention-to-treat basis. Analyses were run using Mplus 8.1 (Muthén & Muthén, 2018). We tested whether children receiving the remotely delivered programme made greater gains in their reading accuracy and phonemic awareness skills than children who received typical remote schooling using multiple regression analyses with Full Information Maximum Likelihood estimators to deal with the missing data (see Enders, 2001). In these analyses, we conducted ANCOVA models with post-test scores as the outcome, and pre-test scores as the covariate and group dummy coded (0 control, 1 intervention). The data and analysis files can be accessed here: https://osf.io/nu6q5/?view_only=94604180bf2d45308d6e8c6c7175574c.

After allocation to the wait-list control group, a total of 36 participants (38%) withdrew as they did not wish to be in the wait-list arm. The ages of the children who were lost from the wait-list control arm did not differ significantly from those who remained, $t = 0.31$, $p = .754$, $d = 0.07$. At follow-up (t2), a further 18 children were lost from the programme arm. In addition, another 13 participants in the

wait-list control arm were lost at follow-up (t2). Children lost to analysis did not differ from children who remained on age or reading ability. As such, it is unlikely that attrition has introduced any bias in the ensuing analyses.

The percentage of missing data, reliabilities, and descriptive statistics for all measures at pre-test (t1) and post-test (t2) are reported in Table 1. There was a moderate proportion of missing data across measures, and this reflected a combination of technological issues with remote assessment, participant availability for testing sessions, and attrition. The standardised word reading scores show, on average, at pretest that children in both arms were within the normal range of reading ability. Children in the wait-list control arm, as a whole, were above average readers. The large majority of average and above-average readers in our sample reflects the broad recruitment strategy we used. The programme group shows lower performance on the reading and phonemic awareness measures at baseline relative to the control group. Note the ANCOVA analysis we undertook is robust in dealing with such imbalances in the two group's baseline scores (Clifton & Clifton, 2019). Whilst the control group's – who completed work set by their schools, as usual – performance remained stable across the 8-week period, the programme group shows a larger improvement on these measures than the control group at post-test.

Primary outcome measure

The primary outcome measure here was single word reading accuracy. We regressed t1 reading accuracy scores and a dummy group variable onto t2 reading accuracy scores. The path diagram in Fig. 3 shows, as expected, that a large amount of variance in post-test reading accuracy is explained by pre-test reading accuracy. However, most critically children receiving the programme made greater gains than the control group. These gains ($d = 0.32$, $p = .011$) are educationally significant (Kraft, 2020;Works Clearing House, 2014).

Secondary outcome measure

The secondary outcome measure here was phonemic awareness as this is a critical determinant of later reading ability. The path diagram in Fig. 4 shows, shows a lower level of stability in phoneme awareness (a weaker autoregressive effect) but large and educationally significant improvement as a result of the intervention ($d = 0.63$, $p = .003$).

Fidelity

As part of the programme, children received 50% of their lessons synchronously with a trained tutor and 50% of their lessons asynchronously. On average, 78% of children completed all the lessons. A senior specialist teacher observed at least one of every child's lessons. We found that in all cases, the tutor delivered all parts of the lesson during the allotted time.

Table 1 Percentage of missing data and descriptive statistics of each measure at pre- and post-test as a function of arm

	% Missing	Reliability	Intervention		Wait-list control	
			M	*SD*	*M*	*SD*
Age (years and months)			10.15	1.24	10.01	1.13
Non-verbal ability (std)		0.89	103.49	12.33	101.32	14.65
Word reading accuracy		0.78				
Pretest (raw)	9.63		41.87	8.48	46.30	10.87
Pretest (std)			104.82	13.17	112.38	15.78
Posttest (raw)	25.19		45.45	9.07	46.31	8.12
Posttest (std)			113.94	19.37	112.67	14.57
Phoneme awareness		0.89				
Pretest	12.59		27.04	5.99	31.57	6.48
Posttest	23.70		32.66	5.43	31.27	6.86

Reliabilities are Cronbach's alpha

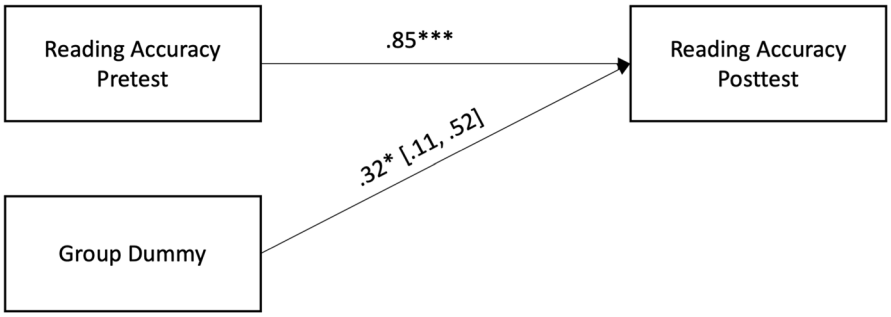

Fig. 3 Path diagram of the effects of the remote programme on reading accuracy. The coefficient between pretest and postest reading accuracy is standardized. The coefficient between the dummy group variable and posttest reading is y-standardized making it equivalent to Cohen's *d* along with 95% CIs

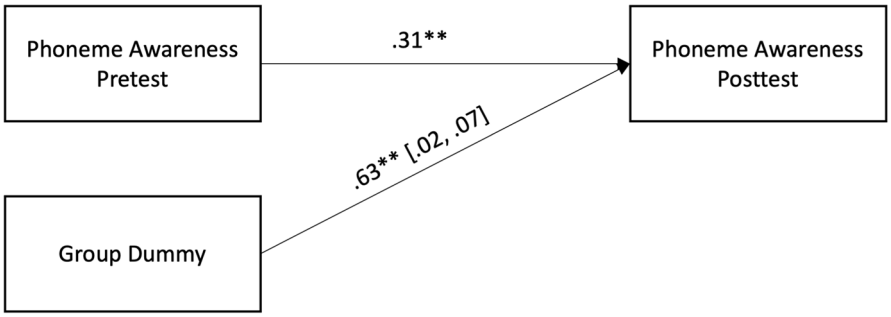

Fig. 4 Path diagram of the effects of the remote programme on phoneme awareness. The coefficient between pretest and postest reading accuracy is standardized. The coefficient between the dummy group variable and posttest reading is y-standardized making it equivalent to Cohen's *d* along with 95% CIs

Discussion

We examined the efficacy of a remotely administered language-rich literacy programme for 8–11-year-old children during a period of school closures. The programme led to educationally significant gains in children's reading accuracy and phonemic awareness during a time when many children were failing to make gains due to school closures. Interestingly, relatively few studies have examined the efficacy of teaching word level skills to older readers, and to our knowledge, no study has rigorously examined the effects of instruction in a group of broadly typical readers (Suggate, 2016). As such, our findings demonstrate evidence for explicit instruction of word level skills in older children. Importantly, though, these findings show that the skills often taught in-class as part of supplementary literacy programmes can be effectively delivered online.

Children who received the programme were, on average, less competent readers than the control group. These baseline differences are unfortunate and may reflect differential drop out from the control group. However, it is clear that there

were large gains in both word reading and phonolgical awareness in the intervention group while the control group made no progress on either measure. ANCOVA models analyses are unaffected by baseline imbalance and so should give an unbiased estimate of the treatment effects here (Clifton & Clifton, 2019). We note however, that the differential drop out from the groups here pose threats to the validity of this study and further studies are needed to confirm the current highly positive findings from a remotely delivered literacy teaching programme.

Teaching literacy remotely

In-class literacy programmes place a significant emphasis on language skills, given the foundational role that these skills play in later reading acquisition and development (Snowling & Hulme, 2021). Interactivity and active engagement between instructor and learner is also traditionally considered pivotal for attracting attention, emphasising, and enunciating new words and providing a contextually rich environment, particularly in the case of young children (Beck et al., 2002; NRP, 2000). Using a high-quality programme which included elements of synchronous and asynchronous instruction, we provided lessons containing the skills known to improve children's reading (e.g., Duff et al., 2008; Hatcher et al., 2004; Bowyer-Crane et al., 2008) in a remote setting whilst preserving the oral language component of the lesson. Children received oral language input whether they received live interaction (synchronous instruction) or pre-recorded video instruction provided by the teacher (asynchronous instruction). Despite concerns over whether remote lesson delivery may impoverish children's learning experiences (Huemer et al., 2008), our data shows that children aged 8–11 years old can make significant gains in core reading skills via remote delivery.

Of interest, these gains were made within a very short time frame, well under the number of hours identified in previous studies for sustained improvement (Hatcher et al., 2006). This may, in part, be due to the relatively typical readers that we recruited into the study. Indeed, the standardised reading scores at baseline revealed that many of the children who took part were already reading within the typical range. Specifically, only 4.4% of children in this study were reading 1.5 SD below their age average at baseline. It is likely that it would take a longer delivery period to see the same effects than we have reported here were we to replicate this study with children who have significant word-level literacy difficulties. It may also be due to the age of the participants in this study. Relatively few studies have examined the effects of targeting word level skills in 8–11 year old children. Instead, many studies target these skills in much younger readers. Interestingly, Suggate (2016) found larger effects for interventions given to older children than younger children. As such, it is possible the larger gains may also be due to the older sample we targeted here.

Direct comparisons between the effect sizes we found here and other studies delivering similar training in person (i.e., not remote) is difficult owing to differing participant samples and methods of evaluation. However, our effects are broadly similar to those reported in Bus and van Ijzendoorn's (1999) meta-analysis. When

examining effect sizes on phonological awareness for in-person studies using a randomised or matched design, they found an effect size of $d=0.72$ which is similar to the current (remote) effect of $d=0.67$. For single word reading, Bus and van Ijzendoorn (1999) report an effect size of $d=0.34$, which is consistent with the present finding of an effect of $d=0.32$. Therefore, we found similar size effects in our remote programme to in-person programmes.

It is important to note the highly unusual circumstances of this study, which was conducted during the national lockdown ensuing from the Covid-19 pandemic. In many cases, the authors were told that this programme was children's only source of structured literacy instruction during the period in question, with many children in the wait-list group completing asynchronously set literacy work. We note that children in the waitlist control group actually showed signs of stagnating reading and phonological growth during the intervention period and in which children undergoing school instruction rapidly lost their skills. Anecdotally, amongst children in the control group, we found the type and frequency of instruction from their schoolteacher varied widely with many children completing literacy activities once a week on their own. We believe this led to difficulties in ensuring children's engagement and providing timely corrective feedback, leading to stagnation of reading and phonological growth in the control group during the intervention period. This finding reflects the conclusions of several studies assessing the detrimental effects of the pandemic on children's literacy and broader educational skills (Bao et al., 2020; Engzell et al., 2021; Tracey et al., 2022).

Implications

We found that, during school closures, when most children's literacy skills were in decline, a remotely delivered a language-rich literacy programme enabled children to maintain and improve key literacy abilities. Our findings have important implications for the delivery of language and reading interventions at scale. Remote teaching minimises costs and time requirements due to travel and can be used when classroom attendance is impossible for a variety of reasons (e.g., chronic illness, school non-attendance, or geographical distance).

Our findings also indicate that well-designed asynchronous methods may provide an economical solution for over-stretched schools to provide struggling readers with an intensive remediation programme, and future work will attempt to replicate these findings at scale. However, some argue for caution in applying remote teaching methods, given recent evidence of increased levels of disengagement in lower socioeconomic districts when pivoting to such methods (Goldhaber et al., 2022). Clearly further work is needed to explore the effectiveness of remotely delivered literacy interventions. Such interventions are clearly attractive because they are potentially highly cost effective and time efficient.

We sought to test the efficacy of a remotely delivered literacy with language programme during a period where typical literacy instruction had faltered across the globe due to Covid-19 school closures. We found that a short, interactive programme which includes a mixture of synchronous and asynchronous lessons can lead to gains

in reading accuracy and phonemic awareness. Further research is needed to consider the relative effects of synchronous and asynchronous instruction in promoting the growth of key literacy related skills remotely.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s11145-023-10502-7.

Acknowledgements We wish to thank the children, parents, and schools who took part in this project. We also wish to thank Dr Richard Watkins for his help in recruitment.

Author contributions CD, RE, MC, and MJ contributed to the study conception and design. GEJ, JD, SC, CW, and RC contributed to the material preparation and data collection. CD and CH performed the analyses. The first draft of the manuscript was written by CD, CH, and MJ, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Funding This work was supported by the Economic Social Research Council (ESRC) under grant number ES/V004050/1. We thank them for supporting this work.

Data availability The data that support the findings of this study are openly available at the Open Science Framework at https://osf.io/wamvp/?view_only=94604180bf2d45308d6e8c6c7175574c.

Declarations

Conflict of interest The authors declare no competing interests. This work was funded by the Economic Social Research Council (ESRC). This study was conducted in accordance with the British Psychological Society's Code of Ethics and Conduct and received approval from School of Human and Behavioural Sciences Ethics Committee, Bangor University.

References

Anwyl-Irvine, A. L., Massonnié, J., Flitton, A., Kirkham, N., & Evershed, J. K. (2020). Gorilla in our midst: An online behavioral experiment builder. *Behavior Research Methods,52*, 388–407. https://doi.org/10.3758/s13428-019-01237-x

Bao, X., Qu, H., Zhang, R., & Hogan, T. P. (2020). Modeling reading ability gain in kindergarten children during COVID-19 school closures. *International Journal of Environmental Research and Public Health,17*(17), 6371. https://doi.org/10.3390/ijerph17176371

Beck, I. L., McKeown, M. G., & Kucan, L. (2002). *Bringing words to life: Robust vocabulary instruction*. Guilford Press.

Bianco, S. D. (2010). Improving student outcomes: Data-driven instruction and fidelity of implementation in a response to intervention (RTI) model. *Teaching Exceptional Children Plus,6*(5), 2–13.

Bowyer-Crane, C., Snowling, M. J., Duff, F. J., Fieldsend, E., Carroll, J. M., Miles, J., Götz, K., & Hulme, C. (2008). Improving early language and literacy skills: Differential effects of an oral language

versus a phonology with reading intervention. *Journal of Child Psychology and Psychiatry,49*(4), 422–432. https://doi.org/10.1111/j.1469-7610.2007.01849.x

Bus, A. G., & Van IJzendoorn, M. H. (1999). Phonological awareness and early reading: A meta-analysis of experimental training studies. *Journal of Educational Psychology,91*(3), 403–414. https://doi.org/10.1037/0022-0663.91.3.403

Caravolas, M., Mikulajová, M., Defior, S., & Seidlová Málková, G. (2018). Multilanguage assessment battery of early literacy. Retrieved from https://www.eldel-mabel.net/test/

Clark, C., & Picton, I. (2021). *Children and young people's reading engagement in 2021: Emerging insight into the impact of the COVID-19* pandemic on reading national literacy trust. https://literacytrust.org.uk/research-services/research-reports/children-and-young-peoples-reading-engagement-in-2021/.

Clarke, P. J., Snowling, M. J., Truelove, E., & Hulme, C. (2010). Ameliorating children's reading-comprehension difficulties: A randomized controlled trial. *Psychological Science,21*(8), 1106–1116. https://doi.org/10.1177/0956797610375449

Clifton, L., & Clifton, D. A. (2019). The correlation between baseline score and post-intervention score, and its implications for statistical analysis. *Trials,20*(1), 1–6. https://doi.org/10.1186/s13063-018-3108-3

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.

Duff, F. J., & Clarke, P. J. (2011). Practitioner review: Reading disorders: What are the effective interventions and how should they be implemented and evaluated? *Journal of Child Psychology and Psychiatry,52*(1), 3–12. https://doi.org/10.1111/j.1469-7610.2010.02310.x

Duff, F. J., Fieldsend, E., Bowyer-Crane, C., Hulme, C., Smith, G., Gibbs, S., & Snowling, M. J. (2008). Reading with vocabulary intervention: Evaluation of an instruction for children with poor response to reading intervention. *Journal of Research in Reading,31*(3), 319–336. https://doi.org/10.1111/j.1467-9817.2008.00376.x

Ehri, L. C. (2011). *Handbook of research on teaching the english language arts*. Routledge.

Enders, C. K. (2001). The performance of the full information maximum likelihood estimator in multiple regression models with missing data. *Educational and Psychological Measurement,61*(5), 713–740. https://doi.org/10.1177/0013164401615001

Engzell, P., Frey, A., & Verhagen, M. D. (2021). Learning loss due to school closures during the COVID-19 pandemic. *Proceedings of the National Academy of Sciences,118*(17), e2022376118. https://doi.org/10.1073/pnas.2022376118

Glutting, J. J., Adams, W., & Sheslow, D. (2000). *Wide range intelligence test [Assessment instrument]*. Wide Range.

Goldhaber, D., Kane, T. J., McEachin, A., Morton, E., Patterson, T., & Staiger, D. O. (2022). *The consequences of remote and hybrid instruction during the pandemic*. National Bureau of Economic Research, No. w30010. https://doi.org/10.3386/w30010

Gough, P., & Tunmer, W. (1986). Decoding, reading, and reading disability. *Remedial and Special Education,7*(1), 6–10. https://doi.org/10.1177/074193258600700104

Graham, S., Liu, X., Aitken, A., Ng, C., Bartlett, B., Harris, K. R., & Holzapfel, J. (2018). Effectiveness of literacy programs balancing reading and writing instruction: A meta-analysis. *Reading Research Quarterly,53*(3), 279–304. https://doi.org/10.1002/rrq.194

Hatcher, P. J., Hulme, C., Miles, J. N., Carroll, J. M., Hatcher, J., Gibbs, S., & Snowling, M. J. (2006). Efficacy of small group reading intervention for beginning readers with reading-delay: A randomised controlled trial. *Journal of Child Psychology and Psychiatry,47*(8), 820–827. https://doi.org/10.1111/j.1469-7610.2005.01559.x

Hatcher, P. J., Hulme, C., & Snowling, M. J. (2004). Explicit phoneme training combined with phonic reading instruction helps young children at risk of reading failure. *Journal of Child Psychology and Psychiatry,45*(2), 338–358. https://doi.org/10.1111/j.1469-7610.2004.00225.x

Huemer, S., Landerl, K., Aro, M., & Lyytinen, H. (2008). Training reading fluency among poor readers of German: Many ways to the goal. *Annals of Dyslexia,58*, 115–137. https://doi.org/10.1007/s11881-008-0017-2

Hulme, C., Bowyer-Crane, C., Carroll, J. M., Duff, F. J., & Snowling, M. J. (2012). The causal role of phoneme awareness and letter-sound knowledge in learning to read: Combining intervention studies with mediation analyses. *Psychological Science,23*(6), 572–577. https://doi.org/10.1177/0956797611435921

Kraft, M. A. (2020). Interpreting effect sizes of education interventions. *Educational Researcher,49*(4), 241–253. https://doi.org/10.3102/0013189X20912798

Kuhfeld, M., Soland, J., & Lewis, K. (2022). Test score patterns across three COVID-19-impacted school years. *Educational Researcher,51*(7), 500–506. https://doi.org/10.3102/0013189X221109178

Livingstone, S. (2012). Critical reflections on the benefits of ICT in education. *Oxford Review of Education,38*(1), 9–24. https://doi.org/10.1080/03054985.2011.577938

McTigue, E. M., Solheim, O. J., Zimmer, W. K., & Uppstad, P. H. (2020). Critically reviewing GraphoGame across the world: Recommendations and cautions for research and implementation of computer-assisted instruction for word-reading acquisition. *Reading Research Quarterly,55*(1), 45–73. https://doi.org/10.1002/rrq.256

Muthén, L. K.., & Muthén, B. O. (2018). *Mplus* (Version 8.1.7) [Computer Software]. Muthén & Muthén. https://www.statmodel.com/

National Reading Panel (US), National Institute of Child Health, & Human Development (US). (2000). *Report of the National Reading Panel: Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction: Reports of the subgroups*. National Institute of Child Health and Human Development, National Institutes of Health.

Reimers, F., & Schleicher, A. (2020). *Schooling disrupted, Schooling Rethought. How the COVID-19 pandemic is changing Education*. OECD. https://globaled.gse.harvard.edu/files/geii/files/education_continuity_v3.pdf.

Rice, M., Erbeli, F., Thompson, C. G., Sallese, M. R., & Fogarty, M. (2022). Phonemic awareness: A meta-analysis for planning effective instruction. *Reading Research Quarterly,57*(4), 1259–1289. https://doi.org/10.1002/rrq.473

Rose, J. (2009). Identifying and teaching children and young people with dyslexia and literacy difficulties. UK Government.

Sayko, S. (2020). *Evidence-based literacy instruction within remote learning environments. White paper*. Comprehensive Centre Network. https://eric.ed.gov/?id=ED608810.

Shaywitz, S. E., Fletcher, J. M., Holahan, J. M., Shneider, A. E., Marchione, K. E., Stuebing, K. K., & Shaywitz, B. A. (1999). Persistence of dyslexia: The connecticut longitudinal study at adolescence. *Pediatrics,104*(6), 1351–1359. https://doi.org/10.1542/peds.104.6.1351

Snowling, M. J., & Hulme, C. (2011). Evidence-based interventions for reading and language difficulties: Creating a virtuous circle. *British Journal of Educational Psychology,81*(1), 1–23. https://doi.org/10.1111/j.2044-8279.2010.02014.x

Snowling, M. J., & Hulme, C. (2021). Annual research review: Reading disorders revisited–The critical importance of oral language. *Journal of Child Psychology and Psychiatry,62*(5), 635–653. https://doi.org/10.1111/jcpp.13324

Suggate, S. P. (2016). A meta-analysis of the long-term effects of phonemic awareness, phonics, fluency, and reading comprehension interventions. *Journal of Learning Disabilities,49*(1), 77–96. https://doi.org/10.1177/0022219414528540

Tomasik, M. J., Helbling, L. A., & Moser, U. (2021). Educational gains of in-person vs. distance learning in primary and secondary schools: A natural experiment during the COVID-19 pandemic school closures in Switzerland. *International Journal of Psychology,56*(4), 566–576.

Tracey, L., Bowyer-Crane, C., Bonetti, S., Nielsen, D., D'Apice, K., & Compton, S. (2022). The impact of the Covid-19 pandemic on children's socio-emotional wellbeing and attainment during the reception year. Research Report. Education Endowment Foundation. https://eric.ed.gov/?id=ED620337.

Treiman, R. (2018). Teaching and learning spelling. *Child Development Perspectives,12*(4), 235–239. https://doi.org/10.1111/cdep.12292

What Works Clearing House (2014). *Procedures and standards handbook*. Retrieved September, 2023, from: https://ies.ed.gov/ncee/wwc/Handbooks#procedures.

Wilkinson, G. S., & Robertson, G. J. (2006). The wide range achievement test–4 (WRAT-4) [Assessment instrument]. *Psychological Assessment Resources*.