Protocol: A cluster randomised controlled trial Of Reciprocal Reading: A teacher training comprehension programme


Published in:
International Journal of Educational Research

Document Version:
Peer reviewed version

Queen's University Belfast - Research Portal:
Link to publication record in Queen's University Belfast Research Portal

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Download date: 19. Apr. 2021
Protocol: A cluster randomised controlled trial of Reciprocal Reading: A teacher training comprehension programme

Abstract

This paper presents the research protocol for a pragmatic RCT of the Reciprocal Reading programme. Reciprocal Reading (RR) is a workforce development programme that supports practicing Teachers/Teaching Assistants develop and deliver comprehension instruction in mainstream UK settings for pupils aged 8 to 11 years. The protocol outlines a research design that will assess whether the RR programme can improve a number of specific outcomes in intervention group pupils, in a sample of schools experiencing higher than average levels of disadvantage. The primary outcome for analysis is reading comprehension with secondary outcomes of overall literacy, reading accuracy and comprehension precursors at the child and school level. The study will also include a process evaluation using qualitative data and quantitative implementation data.

Key Words
Reciprocal Reading; Comprehension; Primary School; Teacher Training; Literacy; RCT

Background

Reading is a foundational skill for learning. Interventions to improve reading skills, particularly at word level, are well-developed and extensively studied. The majority of studies of reading comprehension interventions, however, have been small in scale and quasi-experimental (Snowling & Hulme, 2012) There is currently international interest in improving reading comprehension levels (OECD, 2017; UNESCO, 2009). Existing interventions to address reading comprehension include Inference Training (Kispal, 2008) and reciprocal reading (Palincsar, 1982).
To date reciprocal reading has been implemented largely in the US/NZ. A range of studies have reported positive outcomes from reciprocal reading training programmes (Palincsar, 1982; Palincsar & Brown, 1984; Rosenshine & Meister, 1994; Sporer, Brunstein & Kieschke, 2009; Crawford & Skipp, 2014). For example, Rosenshine and Meister (1994) found an effect size of 0.32 when standardized tests were used across sixteen studies with varying designs. A more recent randomized control study carried out in 41 schools in the UK showed a more modest positive effect (0.09; Crawford & Skipp, 2014).

The following protocol describes a large randomized control trial study aimed at evaluating the impact of Reciprocal Reading on pupils’ attainment in reading comprehension on both a whole class (universal) and targeted basis. This study has been funded by the Education Endowment Foundation in the UK.

**The Intervention**

The Fischer Family Trust Literacy (FFT) Reciprocal Reading training (RR) is delivered by practicing Teachers/Teaching Assistants in mainstream UK settings for pupils aged 8 to 11 years. Workforce development is, therefore, an essential part of the programme. All Teachers/Teaching Assistants involved in delivering the programme will receive two days’ off-site training from FFT. FFT also provide on-site advisory support during delivery of the programme. The training covers the knowledge, skills and understanding that practitioners need to deliver the FFT RR programme in either a universal or a targeted format. The training covers an understanding of the nature of reading comprehension and an evidence-based package of strategies as well as instructional components, such as how to conduct reciprocal reading sessions and associated issues such as choices of texts and the use of planning and recording sheets.

The main reading situation in reciprocal reading instruction is teacher-led, collaborative reading of texts. The task is the use of evidence-based strategies - summarising, questioning, predicting and clarifying - modelled by the teacher and used collaboratively between teacher and students, to derive meaning from the text. The participants are students in mixed-ability Year 4, 5 and 6 classes (8 to 11 years).
Universal (whole class) Version

Teachers involved in the universal version of the programme deliver guided reading sessions of 20-30 minutes in length, once a week, for a minimum of 16 weeks over two academic terms to students aged 8-9 years (Year 4 in primary schools in England). Over the course of the intervention students encounter many texts. The strategies are used flexibly and adapted to the texts. In the universal intervention the reading situation is whole-class, as opposed to small-group in the original version of reciprocal reading. Whole-class or whole-group reciprocal reading sessions are followed by individual tasks, which are based on the reading sessions, in the form of book journal activities.

So the whole class FFT RR programme comprises:

a) A set of strategies – used to strategically process text;
b) An instructional dialogue;
c) Materials – texts;
d) Book journal activities;

Targeted Version

Teachers and Teaching Assistants involved in the targeted version of the RR programme deliver guided-reading sessions of 20-30 minutes in length to small groups of students aged 9 to 11 years (Year 5 and Year 6 in primary schools in England) who have been identified as having reading comprehension skills which are relatively weaker than their reading accuracy. The frequency in the targeted version is twice a week for at least 16 weeks over two academic terms.

The targeted version of the FFT RR programme also comprises:

a) A set of strategies – used to strategically process text;
b) An instructional dialogue;
c) Materials – texts;
d) Book journal activities;
Control group schools will proceed with business as usual, comprising of their normal literacy and specific comprehension instruction practices for students aged 8 to 11 years.

Table 1 Reciprocal Reading TIDieR checklist

<table>
<thead>
<tr>
<th>ITEM No.</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Brief Name</strong></td>
<td>Reciprocal Reading (RR) (two versions: 1. Universal; &amp; 2. Targeted)</td>
</tr>
<tr>
<td>1</td>
<td><strong>Why</strong></td>
</tr>
<tr>
<td>2</td>
<td>Training programme for teachers aimed at improving comprehension ability of pupils aged 8 to 9 years (universal) &amp; pupils aged 9 to 11 years (targeted)</td>
</tr>
<tr>
<td><strong>What</strong></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Materials: A teacher training programme delivered by the Fischer Family Trust Literacy, which includes external school training (for teachers and teaching assistants) interspersed with internal follow up support/training.</td>
</tr>
<tr>
<td>4</td>
<td>Procedures: External school training for both universal and targeted versions is similar. Internal follow up training/support sessions are tailored for the two different versions but have overarching themes of comprehension behaviours, awareness and school culture.</td>
</tr>
<tr>
<td><strong>Who Provided</strong></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Reciprocal Reading Trainer provides teacher internal and external training. Teachers and teaching assistants provide reciprocal reading activities to pupils based on their training</td>
</tr>
<tr>
<td><strong>How</strong></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Initial training sessions provided to groups of teachers</td>
</tr>
<tr>
<td><strong>Where</strong></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>External training provided out of school setting. Internal training provided in school setting including classroom.</td>
</tr>
</tbody>
</table>
**When and how much**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>There are two external training sessions and three internal follow up sessions over a 16 week period. Teachers are utilising their training over the course of the year.</td>
</tr>
</tbody>
</table>

**Tailoring**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>9</td>
<td>The programme logic model was refined during the first Phase of the research and is included in Figure 1.</td>
</tr>
</tbody>
</table>

**Modifications**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>No programme modifications are being made during the trial. Suggestions for modifications based on process evaluation data will be made in the final report.</td>
</tr>
</tbody>
</table>

**How well**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Planned: This will be assessed through the research process evaluation</td>
</tr>
<tr>
<td>12</td>
<td>Actual: This will be assessed through the programme Cluster Randomised Controlled Trial evaluation.</td>
</tr>
</tbody>
</table>

**Programme Theory**

The team of independent evaluators has worked with the intervention team (FFT) to design a logic model for the intervention. Figure 1 provides a graphical representation of the programme components (inputs, outputs and outcomes). The logic model also describes the theories to be tested in this experiment, which can be categorized under the following headings: 1. Theory of intervention (i.e., how intervention outputs and activities impact on proximal outcomes); Theory of change (i.e., how proximal outcomes result in change on distal outcomes); and Implementation Theory (i.e., how implementation factors relate to both proximal and distal programme outcomes.) Specific details on these theories are described in more detail in the following sections. The methodology for investigating each of the three theories is also described.
The programme logic model will be updated on completion of the study with results indicating whether the various theories are supported or rejected.
Figure 1 - Emerging RR Logic Model

<table>
<thead>
<tr>
<th>Program Inputs</th>
<th>Program Outputs</th>
<th>Program Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>FFT Literacy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Targeted Pupils</td>
<td></td>
<td>Theory of Change</td>
</tr>
</tbody>
</table>

Theory of Intervention

- Teachers Comprehension awareness and behaviours

Implementation Factors: pupil engagement; teacher engagement; lesson exposure (dosage); targeted vs whole class; and disadvantage (FSM)

Implementation Factors

- Pupil Literacy Ability
- Pupil reading accuracy ability

1. Pupil meta-cognition about reading and comprehension behaviours
2. School Comprehension culture/ethos
3. Pupil Comprehension ability

FFT Literacy

- Schools
- Targeted Pupils

Whole Class

Program Inputs

Program Outputs

Program Outcomes

Implementation Factors

- FFT Literacy
- Schools
- Targeted Pupils

External training session 1) 1 day Introduction to RR Model

Internal follow up support 1) 0.5 day focused on Comprehension knowledge and skills

External training session 2) 1 day focused on challenge and think

Internal follow up support 2) 0.5 day focused on comprehension awareness Year 4 & 5/6 differences

Internal follow up support 3) 0.5 day focusing on school comprehension culture
The Theory of Intervention describes the relationship between programme outputs and both proximal and distal outcomes.

A lack of explicit comprehension instruction has been shown to be an issue in pedagogy associated with reading comprehension (Pressley, 2000). Teachers, therefore, need to have their own understanding of the component skills of reading comprehension (Oakhill, Cain & Elbro, 2015). Within a cognitive paradigm, reading comprehension is theorized as constructively responsive reading in which the reader seeks to identify the overall meaning of the text by actively searching, reflecting on and responding to text in pursuit of its main ideas (Pressley and Afflerback, 1995).

One of the key elements of the FFT RR intervention is high quality professional development regarding evidence-informed reading comprehension instruction (Higgins, Katsipataki & Coleman, 2014). It has been shown that metacognition about reading can be enhanced through teaching practices (Brozo & Simpson, 2007; Guthrie, Wigfield and You, 2012; Guthrie, Ho & Klauda, 2013; Reeve, 2012).

The first component pathway of the Reciprocal Reading theory of intervention, therefore, is that programme training days aim to improve teachers’ comprehension awareness and behaviours. Teachers are trained on both how to deliver the
programme, and how to identify children who may have reading comprehension impairments. RR training explains the simple view of reading (Gough & Tunmer, 1986) to teachers and how to identify the pupils who may fit within the ‘good decoders/poor comprehenders’ quadrant (Nation & Snowling, 1997).

This aspect of the Theory of Intervention will be investigated by analyzing the reading comprehension scores of those pupils identified by teachers as having reading comprehension impairment, namely whether the teacher guide to identifying reading comprehension impairment correspond to reading scores. Impact of teacher training on comprehension awareness and behaviours will also be investigated through teacher surveys and interviews.

The second pathway of the Theory of Intervention is that programme training aims to impact school comprehension culture and ethos. The programme aims to improve awareness and prioritisation of reading comprehension in schools. This pathway of the Theory of Intervention will be investigated through teacher and head teacher surveys of school culture and ethos (measured prior to pre-test and randomization through a survey attached to the Memorandum of Understanding signed by each school, and which will be followed-up at post-test).
Theory of Change

There are three component pathways within the Theory of Change.

Firstly, the programme aims to effect change on pupil meta-cognition about reading and comprehension behaviours via teaching and school culture (themselves theoretically improved by the earlier training, described above in the theory of intervention).

According to social-cognitive theory, for higher order thinking skills to develop, such as those inherent in reading comprehension, they must first occur socially (Vygotsky, 1978; Collins, Brown & Newman, 1989). Pedagogical approaches underpinned by this theory are characterized by student acquisition of complex skills through social modelling and explicit teaching whereby the student witnesses the skills displayed by a competent user (2009; Palincsar, Ranson, & Derber, 1989). In the case of scaffolded reading comprehension instruction, the competent user delivers explicit cognitive strategy instruction (Cromley & Azevedo, 2007; Piloneta & Medina, 2009; Compton et al, 2009). The Reciprocal Reading intervention theoretically targets social modelling, explicit teaching and explicit cognitive strategy instruction through its emphasis on teacher knowledge, explicit lessons and teaching of comprehension strategies.

Scaffolded dialogue, it is hypothesized, leads to the transfer of responsibility for active strategy-use from teacher to students (Van de Pol, Volman and Beishuisen, 2010). The strategies, particularly summarizing and questioning, foster students’ own ability to monitor their understanding whilst reading text (Higgins, Katsipataki and
Colemen, 2014: 13). In addition, the FFT RR intervention trains teachers to model and scaffold comprehension monitoring awareness and behaviours; the shared dialogues include language to talk about the process of reading and the success or otherwise of the strategies. In this way students acquire the ability to monitor their understanding of the text, know when this understanding has broken down and know which of the strategies to use to repair this and when (Brown et al, 1981; Erlich, 1996; Baker; 1996; Pressley, 2000). This enhances student ability to steer and control their approach to reading tasks based on knowledge about the task and how to carry it out (Chambers, Cantrell, Almasi, Carter, Rintamaa, and Maden, 2015; Edmonds et al; 2009; Brown, 1980; Kucan & Palincsar, 2011) and skills in self-management and the regulation of their own behaviours when reading texts (Zimmerman, 1998;; Scammacca et al, 2007; Chambers Cantrell et al, 2015).

The hypothesized result is improved reading comprehension and, ultimately, increased scores in standardised assessment of academic attainments (Crawford & Skipp, 2014; Rosenshine & Meister, 1994).

This particular pathway of change will be investigated by measuring pupils’ meta-cognition about reading and comprehension behaviours at post-test.

The second pathway of the Theory of Change is that pupil meta-cognition about reading and comprehension behaviours may be associated with outcome change in pupil comprehension ability. Comprehension ability is significantly predicted by use of effective, higher-level comprehension strategies (Cantrell et al., 2010) and by metacognitive strategies (Artelt, Schiefele, & Schneider, 2001; Brown, Palincsar, & Armbruster, 1984; OECD, 2010). This will be investigated by analysing if pupils’ metacognition about reading and reading comprehension behaviours are significantly predictive of their outcome change in comprehension ability.
The third pathway in the theory of change describes how change in reading comprehension ability will have a subsequent effect on overall literacy. If a pupil experiences improvement in reading comprehension score, as assessed by the passage comprehension sub-component of the New Group Reading Test (NGRT), this will naturally improve their overall literacy score.

It is, however, also possible that change in pupil comprehension ability could affect overall literacy through an interaction with reading accuracy. Although poor comprehenders are often described as having intact reading accuracy, they may show subtle but significant differences in reading accuracy skills. For example, poor comprehenders have been found to have poorer accuracy at reading exception words and low-frequency words (Nation & Snowling, 1998). Seidenberg & McClelland’s (1989) Triangle Model of reading illustrates how grammatical context, semantics, phonology and orthography interact in the process of word recognition. The role of semantics and grammar may therefore affect word reading accuracy, especially when the reading accuracy assessment is in the context of a sentence, such as the NGRT sentence completion test. The primary analysis in this study will focus on the outcome change in reading comprehension and overall literacy; if gains in pupil reading accuracy are also found, this then may be evidence of the role comprehension strategies play in improving reading accuracy, as suggested by Seidenberg and
McClelland’s Triangle model (1998).

**Implementation Theory**

In addition to investigating the relationship between the intervention, outputs and outcomes, this study will explore which implementation factors may be related to outcome change. These implementation factors cover pupil disadvantage, contextual factors and participants’ levels of programme engagement.

Reading accuracy is a strong longitudinal predictor of later reading comprehension. Muter, Hulme, Snowling and Stevenson (2004) found that word reading, when compared with vocabulary, phoneme skills, grammatical skills and letter knowledge was the strongest predictor of reading comprehension. Pupil reading accuracy will be analysed as an implementation factor for outcome change, as it is possible that pupils’ starting point (pre-test) in word reading may affect the change they experience during the course of the programme.

Two variants of the programme will be delivered: targeted and whole class. The targeted intervention will be delivered only to pupils who have been identified as having reading comprehension impairments. An equal number of pupils within the classes receiving the whole class intervention have also been identified as having
reading comprehension impairments. This will allow comparison of outcome change for reading comprehension impaired pupils between both targeted and whole class interventions.

Pupil engagement and teacher engagement (measured through post-test surveys) will also be analysed as implementation factors for outcome change.

Dosage

The relationship between pupil disadvantage and outcome change will be investigated. This study’s primary analysis will analyse overall effect sizes for pupils’ outcome change in reading comprehension and literacy. It is possible that a subgroup of pupils, as determined by disadvantage may respond differently to the programme and reading progress will therefore also be analysed when considering these group differences. Disadvantage is a significant predictor of reading level (as assessed in terms of accuracy, comprehension and rate) (McPhillips & Sheehy, 2004). Furthermore differences between pupils in receipt of FSM and those not in receipt of FSM, in outcome change of reading have been found in an earlier RCT of language intervention pupils (Thurston, Roseth, O’Hare, Davison and Stark, 2016).

Programme dosage will be investigated as an implementation factor by way of a non-compliance analysis. Schools who do report weekly dosage below the recommended dosage will be coded as non-compliant and the primary analysis of outcomes will be repeated including compliance as a predictor of outcome.

Research Plan

Research questions

The FFT RR study design will be a cluster randomised controlled trial (RCT) and will be complemented by a process evaluation. The study will primarily look at the effect of the RR training on reading comprehension, overall reading and reading accuracy in children in primary schools aged 8 to 11 years. In doing so, the trial will measure the feasibility of implementing the FFT RR training by conducting pre and post-test measures of children in 97 schools.
The study will address the following questions:

1. What is the impact of the FFT RR training programme at post-test on reading outcomes (primary and secondary) in pupils participating in a universal/whole-class version?
2. What is the impact of the FFT RR training programme at post-test on reading outcomes (primary and secondary) in pupils participating in a targeted version which involves pupils identified with having relatively good reading accuracy with relatively weaker reading comprehension skills?
3. What evidence is there to support the pathways for change in both primary and secondary outcomes as proposed in the logic model for both the universal and targeted versions of the programme?
4. What is the relationship between outcomes and implementation factors for both the universal and targeted versions of the programme?
5. What does the implementation process data tell us about how the programme was implemented?

The study will also look at secondary outcomes such as teacher understanding of reading comprehension and pupil understanding of the RR strategies.

**Design Summary**

1. Cluster RCT Evaluation: The main outcomes of the RR training will be evaluated using a cluster RCT with control group analysis. The RCT will test for changes in pupils reading outcomes (reading comprehension, overall reading and reading accuracy). Both the universal whole class version and the targeted small-group version of the implementation will be tested. Any changes in the intervention group receiving the FFT RR training will be measured against the control group who do not receive the treatment.

2. Process evaluation. A process evaluation will supplement the RCT to measure implementation factors. It will seek to assess dosage, reach, fidelity and quality. To help assess this all teachers and teaching assistants delivering the programme will complete a questionnaire, an audit tool will be administered by FFT and observations
and interviews will be carried out in ten case study schools.

**Assessment procedures**

All children taking part in both the universal and targeted versions of programme delivery will be tested before and after the intervention. The primary outcomes of the trial will be three attainment indicators from the NGRT. This is an adaptive test which has high reliability (GL Assessment, 2018).

a. Pre-test. All children will be tested in exam conditions by schools prior to teacher training and programme intervention using a digital version of the standardized pre-test measure (New Group Reading Test).

b. Post-test measures will be repeated with all children after at least 16 weeks of intervention over two academic terms. The post-test will be administered by the evaluation team.

c. The survey includes items on teacher level outcomes (comprehension behaviour and awareness), implementation issues and comprehension culture of the school.

**Table 2: Measurement tools**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Instrument</th>
<th>Completed by</th>
<th>Alpha values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Outcomes measure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reading Comprehension</td>
<td>New Group Reading Test – Passage Comprehension subtest</td>
<td>Pupil</td>
<td>0.9 (GL Assessment, 2018)</td>
</tr>
<tr>
<td>Overall reading</td>
<td>New Group Reading Test</td>
<td>Pupil</td>
<td>0.9 (GL Assessment, 2018)</td>
</tr>
<tr>
<td>Secondary Outcomes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>measures</td>
<td></td>
<td></td>
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<tr>
<td>----------------------------------</td>
<td>------------------------------</td>
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<td>----------</td>
</tr>
<tr>
<td>Reading accuracy</td>
<td>New Group Reading Test – Sentence completion subtest</td>
<td>Pupil</td>
<td>0.9 (GL Assessment, 2018)</td>
</tr>
<tr>
<td>Pupil meta-cognition about reading and comprehension behaviours</td>
<td>–Bespoke measure pupil meta-cognition about reading and comprehension behaviours questionnaire</td>
<td>Pupil</td>
<td>n/a</td>
</tr>
<tr>
<td>Teacher Comprehension awareness, behaviour and attitude</td>
<td>-Bespoke measure teacher comprehension pedagogy development questionnaire (RR version)</td>
<td>Teacher</td>
<td>n/a</td>
</tr>
<tr>
<td>School comprehension ethos</td>
<td>MOU &amp; Principal survey</td>
<td>Principal</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Implementation factors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dosage</td>
<td>24 week implementation plan</td>
<td>Teacher</td>
<td>n/a</td>
</tr>
<tr>
<td>Pupil engagement</td>
<td>Pupil Survey</td>
<td>Pupil</td>
<td>n/a</td>
</tr>
<tr>
<td>Teacher engagement</td>
<td>Teacher survey</td>
<td>Teacher</td>
<td>n/a</td>
</tr>
<tr>
<td>Targeted vs Whole class</td>
<td>Selection tool</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Sample

Participants

The study is being conducted in 97 primary schools in English. The schools were recruited by the evaluation team from March 2017 to May 2017. The schools were selected to ensure that there is an overall mean in the implementation group (97 schools) of at least 29% FSM Ever, which is the national average. Further eligibility criteria are that schools have not received the FFT literacy package of training to deliver RR and are not involved in another EEF trial for students aged 8 to 11 years.

In each participating schools the universal intervention will be delivered to all pupils aged 8 to 9 years (Year 4) and the targeted intervention will be delivered to selected pupils aged 9 to 11 years (Year 5 & Year 6). The eligibility criteria for the targeted version are pupils who are poor at reading comprehension but relatively good at reading with accuracy. The children in this category will be selected by teachers using guidance and materials developed by FFT literacy in collaboration with the evaluation team. There was no theoretical justification for selecting 8 to 9 years (Year 4) as the age range for trialing the universal intervention and 9 to 11 years (Year 5 and Year 6) as the age range for trialing the targeted intervention. Assigning different Year groups in the same schools to participate in different versions of the programme allowed evaluation of the two different versions of the programme within one sample of schools.

Head teachers from each of the schools were asked to read and sign a memorandum of understanding (MoU) which explains their commitments to the programme and the research. Schools also completed a short-questionnaire on usual literacy practice within the school with a focus on reading comprehension practices. Parental consent is on an opt-out basis.

Schools allocated to the control group will not receive the training but will proceed as normal with regular curriculum and usual classroom activity.
Pupil name, DOB and UPNs will be gathered from the participating schools will all other information being retrieved from the National Pupil Database.

Sample size calculation

The RCT will assess both the whole group approach and the more targeted version of the programme and, as such, needs to be adequately powered for both. As the targeted approach, with fewer pupils, requires the higher number of schools, the following power calculations have been based on the targeted approach.

Effect sizes for literacy interventions evaluated through a good quality RCT design would tend typically be in the range of 0.2-0.3 (Biggart, Kerr, O’Hare and Connolly, 2013; Borman, Slavin, Cheung, Chamberlin, Madder and Chambers, 2007; Tymms, Merrell, Thurston, Andor, Topping and Miller, 2011). The more conservative effect size of 0.2 has been used in the power calculation below for the study.

![Figure 2. Study power according to number of clusters](image-url)
Figure 2. shows a power calculation for the RR trial provided by Optimal Design software using estimates of $ES=0.2 \; \rho=0.05; \; ICC = .14; \; r^2=0.50$ (due to having a pre-test of NGRT); average class size $n=20$. Study power is shown according to number of clusters.

This calculation suggests a total sample size of 94 schools (clusters) to detect a significant effect if present with a power of .8.

In conclusion, the nature of the trial with 97 schools (which is a limiting factor due to project team capacity to deliver training) would permit the well powered assessment of outcomes of the programme in comparison to control schools if an effect of 0.2 is present.

**Randomisation**

Randomisation was carried out in July 2017 after pre-test in June 2017. Stratification was used as part of the randomisation process. Stratification improves the precision of the estimates by helping to ensure that the treatment indicator is orthogonal to the other covariates (Cox and Reid 2000).

In this case we conducted minimisation through the QMinim software package. Minimisation is a well-recognised approach that uses algorithms to ensure a balance on certain covariates between the control and intervention schools at baseline, and is especially useful when randomising a small number of cases (Torgerson and Torgerson, 2007). Minimisation was used to ensure the schools were as evenly matched as possible. A number of school level covariates was used in the matching process specifically: reading comprehension score (NGRT passage comprehension), % FSMEver, reading accuracy score (NGRT sentence completion). Median values were calculated for each of these characteristics to determine a mid-cut point and the creation of dichotomous variables, coding schools as “High” or “Low” for each of these characteristics. These variables were then entered into QMinim for each school; and all variables given a weight of one with the exception of reading comprehension which was double weighted as an important predictor of the outcome of interest. This randomisation process resulted in 51 schools being assigned to the Intervention condition and 49 being assigned to the Control condition.
Analysis Plan

Primary Intention-to-Treat (ITT) Analysis
Analysis will be carried out using STATA. Analysis will be conducted on an intention-to-treat basis. The main effects of the intervention will be estimated using multilevel random-effects linear regression modelling to take account of the clustered nature of the data and a series of models will be estimated for each outcome (where pupil is level 1 and school is level 2). Multilevel random effects models allow for estimates of variance of both levels.
Firstly, analysis will be conducted for the universal intervention with the NGRT comprehension score, overall reading score forming the dependent variable and the independent variables including a dummy variable representing whether the child was a member of the intervention or control group (coded ‘1’ and ‘0’ respectively) and pupils’ baseline scores at pre-test.
Secondly, this analysis will be repeated for the targeted intervention.

Imbalance at Baseline for Analysed Groups
The analysis used to help determine whether attrition has led to imbalance at baseline will be multi-level regression models. These will test for differences in reading comprehension, FSMEver % and reading accuracy between the Control and Intervention groups. Imbalance at baseline will be reported as effect size. Effect size will be calculated using the following method:
The standard error will be used to calculate 95% confidence intervals for the coefficient, using the formula:

\[
95\% \text{ CI} = \text{coefficient} \pm (1.96 \times \text{standard error})
\]

Upper limit of CI = coefficient + (1.96 x standard error)
Lower limit of CI = coefficient + (1.96 x standard error)

Effect size will be calculated for the primary outcomes – overall reading score and reading comprehension score. Effect size (Hedges’ g) will be calculated as the standardised mean difference between the control and intervention groups, using the
pooled standard deviation. The pooled standard deviation will be calculated using the formula:

$$s = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}}$$

Hedges’ g will then be calculated as:

$$g = \frac{\text{coefficient}}{\text{pooled standard deviation}}$$

Missing Data
Schools that drop out of delivering the intervention will be encouraged to allow post-testing and will still be included in an intention-to-treat analysis. If the proportion of missing data is higher than 5%, a ‘missing at random’ data analysis will tell us whether imputation is required. If so, data will be imputed using multiple imputation which will be presented as a sensitivity analysis. The missing at random analysis will be carried out in Stata and will determine if the pattern of missing data is related to the primary outcome. Schools that were pre-tested but then dropped out of the trial will be included as ITT.

Non-Compliance with Intervention
Dosage will be calculated using the naturally occurring data from FFT as recorded by teachers in the weekly lesson frequency recording tool given to teachers by FFT on their initial training day. This survey asks teachers to record the number of lessons and the average length of lessons on a weekly basis. The progress in completion of this recording tool will be checked during the schools follow-up training visit by FFT. QUB fieldworkers will collect this survey from teachers on the day of the post-test.
Dosage will be included as an independent variable in the exploratory analysis of programme implementation factors. We will also explore the use of CACE analysis2. Year groups of participants will be coded as compliant/non-compliant based on comparing their teachers’ reported dosage with the minimum required dosage. FFT have reported that minimum dosage should be two sessions of twenty minutes per week for twelve weeks for the Targeted Intervention, and one session of twenty minutes per week for twelve weeks for the whole class intervention. Year 4 groups (whole class intervention, pupils aged 8-9 years) with a reported dosage of under 240
minutes, and Year 5 and 6 groups (targeted intervention, pupils aged 9 to 11 years) with a reported dosage of under 480 minutes will be coded as non-compliant. A regression analysis will then be conducted on the same scores as the primary analysis, but also including compliance level as a predictor.

Secondary Outcome Analyses
Secondary analyses will investigate differences between the control and intervention groups in post-test reading accuracy, pupil meta-cognition and pupil comprehension behaviour, controlling for pre-test reading score. This analysis will be carried out for the universal intervention and for the targeted intervention.

Additional Analyses
Additional analysis will be conducted to explore the pathways for change in both primary and secondary outcomes as proposed in the logic model. This will be carried out for both the universal intervention and the targeted intervention.

Process Evaluation
Structured observations will also be carried out in a set of 10 case study schools using an EEF-funded instrument developed for the evaluation of previous Paired Reading studies. Case studies will also include pupil focus groups and teacher interviews.

These sources of data will be used to assess several issues including the following: the centrality of the teacher role in programme; how pupils adapt to their respective roles (summarising, questioning, clarifying and predicting); facilitators and barriers to programme implementation; exploration of programme theory of change and intervention; and the perceptions over the scalability of the programme.

Naturally occurring data will also be collected from FFT literacy at the end of the programme (including their records and training notes).

Personnel
The programme delivery team (FFT) includes Andy Taylor and John Catron.
The research team, appointed by the Educational Endowment Foundation (EEF) consists of Dr Liam O’Hare (Principal Investigator), Dr Andy Biggart, Dr Patrick Stark, Dr Maria Cockerill, Dr Katrina Lloyd, Dr Sheila McConnellogue, all from the Centre for Evidence and Social Innovation, Queen’s University Belfast. Professor Paul Connolly, also from the Centre for Evidence and Social Innovation, Queen’s University Belfast, will act as an overall expert consultant for the project.

**Timescales**

The planned timescale for the research is from January 2017 until December 2018. Table 3 below outlines the timeline for the study

<table>
<thead>
<tr>
<th>Task/activity</th>
<th>Date/deadline</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set up meetings</td>
<td>Jan 17- Jun 17</td>
<td>QUB and FFT</td>
</tr>
<tr>
<td>Literature review</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Logical model/theory of development and review</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establish methods of data collection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethical approval</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recruit schools to trial and completion of Memorandum of Understanding and baseline school survey</td>
<td>Jan 17 - Jun 17</td>
<td>QUB</td>
</tr>
<tr>
<td>Consent Process</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unique pupil data collected from schools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-test data collected in schools</td>
<td>Jun 17 – Sep 17</td>
<td>QUB</td>
</tr>
<tr>
<td>Randomization to condition</td>
<td></td>
<td></td>
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<tr>
<td>Refinement of methods of data collection including surveys and observation tool</td>
<td>Apr 17 – Sep 17</td>
<td>QUB and FFT</td>
</tr>
<tr>
<td>Identify naturally occurring data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher and TA training</td>
<td>Sep 17 – Dec 17</td>
<td>FFT</td>
</tr>
<tr>
<td>Develop school interviews and school survey</td>
<td>Oct 17 – Dec 17</td>
<td>QUB</td>
</tr>
<tr>
<td>Piloting of observation tool</td>
<td>Jan 18 – Mar 18</td>
<td>QUB</td>
</tr>
</tbody>
</table>
Table 3: Work plan and timeline for the protocol

Cost

The cost of implementing the programme will include intervention materials, training costs, substitute teaching costs and personnel time spent on delivering the programme with follow up support. The cost of the FFT RR implementation will be estimated per pupil over a one-year period for both the universal and the targeted approach.

Ethics

Ethics was applied for through the ethics committee in the School of Social Sciences Education and Social Work at Queen’s University Belfast and granted on 23 March 2017.

Information sheets were issued to the parents of all pupils potentially receiving the programme in May 2017. These information sheets also included a form for parents to return if they wished to remove their child’s data from the data processing at both pre-test (June 2017) and post-test (June 2018), i.e. QUB would not access their child’s reading scores or NPD data. Schools will be provided with an information sheet.
regarding compliance with the General Data Protection Regulation (GDPR). All pupil data will be treated with the strictest confidence and will be stored in accordance with the data protection legislation, including the General Data Protection Regulation (GDPR) which comes into effect in May 2018. Personal data will be processed as per condition 6(1)e of the GDPR under public interest purposes, because the research is considered to be a “task carried out in the public interest”.

The trial has been registered on the ISRCTN website and summarised here: http://www.isrctn.com/ISRCTN81582662

Acknowledgement

This work has been funded by a grant from the Education Endowment Foundation

References


Durlak, J. A. (2015). Studying program implementation is not easy but it is essential. Prevention Science, 16(8), 1123-1127.


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