Statistical Analysis Plan for Research Learning Communities Project
University of Bristol

INTERVENTION	**Research Learning Communities Project**
DEVELOPER	Institute of Education
EVALUATOR	University of Bristol
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1. Introduction

The aim of the Research Learning Communities (RLC) project was to promote and embed the use of research in schools. During the 2014/15 and 2015/16 academic years, the project worked with 60 primary schools to raise teachers' awareness, understanding and use of research in developing their practice. This involved the recruitment of two to three "Evidence Champions" for each school, at least one of whom was the head teacher or other senior leader. Each RLC then worked with evidence champions from around five schools, who met for a one-day workshop four times in each academic year, to examine research and evidence relating to an agreed area of focus. The evidence champions took ideas back to their schools to develop, apply and evaluate school- or key-stage-wide improvement strategies based on this evidence. The purpose of the statistical analysis detailed in this plan is to determine the impact of the RLCs on pupil attainment in Key Stage 2, and on teachers' awareness, understanding and use of research.

2. Study design

The study exclusively focused on the primary sector. 119 primary schools were recruited to take part in the project. Conditions for participation were that at least 75% of their KS2 teachers completed a baseline survey on their use of research evidence, and the Head teacher and Chair of Governors were required to sign a Memorandum of Understanding. This included an agreement to support Evidence Champions' participation in RLCs, to provide class lists and Unique Pupil Numbers (UPNs) for pupils in the 2014/15 Year 5 cohort and 2015/16 Year 6 cohort, and for teachers to complete another two rounds of surveys at the end of the 2014/15 and 2015/16 academic years.

The schools were then allocated to a treatment or control group using the minimisation method, based on size of school, percentage of pupils eligible for free school meals (FSM), and KS2 attainment (for further details on this see section on randomisation below).

Two or three "Evidence Champions" were selected in each of the treatment schools (at least one of whom was from senior management), and these individuals participated in the RLCs. The RLCs worked with the evidence champions from around five schools, meeting for a one-day workshop four times a year for the duration of the project (8 workshops in total) to examine research and evidence relating to an agreed area of focus. The role of evidence champions was to take back ideas to their schools to develop, apply and evaluate school- or key-stage-wide improvement strategies based on this evidence. They were also expected to support other teachers in the school in terms of raising their awareness, understanding and use of research in developing practice. In some schools the evidence champions changed from Year 1 to Year 2 of project.

2016 KS2 attainment data in literacy (and numeracy) will be used to determine the impact of the RLC intervention on pupil attainment outcomes. This data relates to the cohort of pupils who were in year 5 at the start of the project (intention to treat sample). The following measurements will be used as co-variates in this analysis: pupil's prior attainment (measured by their KS1 attainment in 2012); school engagement with the programme (measured by the attendance of Evidence Champions at eight separate workshops over the course of the project); and pupil eligibility for Free School Meals (taken from the PLASC/School Census). A second stage of the KS2 outcome analysis will involve also linking the teacher survey data with pupil attainment data to understand whether different levels of teacher awareness, understanding and use of research can explain or are related to differences in pupil attainment (see analysis section for more details on this).

Teacher surveys, containing six distinct outcome measures, were used to assess the impact of the RLC project on teacher outcomes (teachers' awareness, understanding and use of research in round 2 and 3 surveys). A baseline survey (Round 1) was administered to all schools in summer 2014. A second survey was administered at the end of the first year of the intervention in summer 2015 (Round 2), and a final survey was conducted in summer 2016 at the end of the second year of the intervention (Round 3).

3. Protocol changes

The original protocol stated that schools would be allocated to treatment and control groups using the minimisation method based on size of school, percentage of pupils eligible for free school meals (FSM), percentage of pupils with English as an Additional Language (EAL), percentage of boys, and percentage of pupils with Special Educational Needs (SEN). The protocol has now been amended to reflect the fact that the minimisation was based on size of unit, size of school, average percentage of pupils eligible for free school meals (FSM) in each unit, and average KS2 attainment in each unit (see section 4 below for more detail). Percentages of EAL, gender, and SEN were not used as too many variables would have made the minimisation problematic.

4. Randomisation

Schools were allocated to treatment and control groups following the completion of the baseline survey in the summer term, 2014. This was achieved by using the minimisation method to ensure a balance of school-level variables. These included:

- Size of school:
    - Small - 210 pupils or fewer (one class of 30 per year);
    - Medium - between 211 to 420 pupils (between 1 and 2 classes per year);
    - Large - over 420 pupils (more than 2 classes per year).
- % of pupils on FSM:
    - High - above the 2013 national average of 19.2% for maintained nursery and primary schools;
    - Low - the 2013 national average or below.
- Attainment at KS2:
    - High - above the 2013 national average of 75% achieving level 4 in reading, writing and maths;
    - Low - the 2013 national average or below.

Schools were recruited to the project in units of either single schools or federations or alliances, comprising two or more schools. Table 1 below shows the breakdown of schools recruited to the project by type of unit. A total of 119 schools were recruited in 71 units.

Table 1: Schools Recruited to the Project by Type of Unit

Type of Unit	Number Recruited	
	Units	Schools
Single schools	54	54
Pairs of schools	6	12
Alliance/federation of three schools	3	9
Alliance/federation of four schools	3	12
Alliance/federation of six schools or more	5	32
Total	**71**	**119**

The five large alliances of 6 schools or more (comprising 32 schools in total) were split into two groups using the minimisation method, based on the size of school, percentage of pupils eligible for free school meals (FSM), and KS2 attainment (see detailed categories above). Of these split alliances, 16 schools were randomly allocated to the treatment condition, and 16 to the control condition.

The remaining schools were recruited in units of either single schools, or federations or alliances which were in pairs or groups of three or four schools. These **units** were then allocated to the treatment or control group using the minimisation method, based on size of unit (single school, two or

three schools, and four schools), average size of school in each unit, average percentage of pupils eligible for free school meals (FSM) in each unit, and average KS2 attainment in each unit (see detailed categories above). The majority of units comprised single schools, but this method allowed for federations of schools or alliances who wanted to work together.

Using the method outlined above, 60 primary schools were allocated to the treatment group and 59 schools were allocated to the control group. The detailed breakdown is provided in Table 2.

Table 2: Allocation of Schools to Control and Treatment Schools

Type of Unit	Number Recruited		Number of Schools Allocated to:	
	Units	Schools	Control	Treatment
Single schools	54	54	27	27
Pairs of schools	6	12	6	6
Alliance/federation of three schools	3	9	6	3
Alliance/federation of four schools	3	12	4	8
Alliance/federation of six or more schools	5	32	16	16
Total	**71**	**119**	**59**	**60**

The MinimPy software[1] was used to conduct the randomisation.

5. Calculation of sample size

Power calculations were used to determine an appropriate sample size for the project with various assumptions being made about the structure of the data. A conservative calculation of the minimum detectable effect size was made using Optimal Design software[2] with the following assumptions:
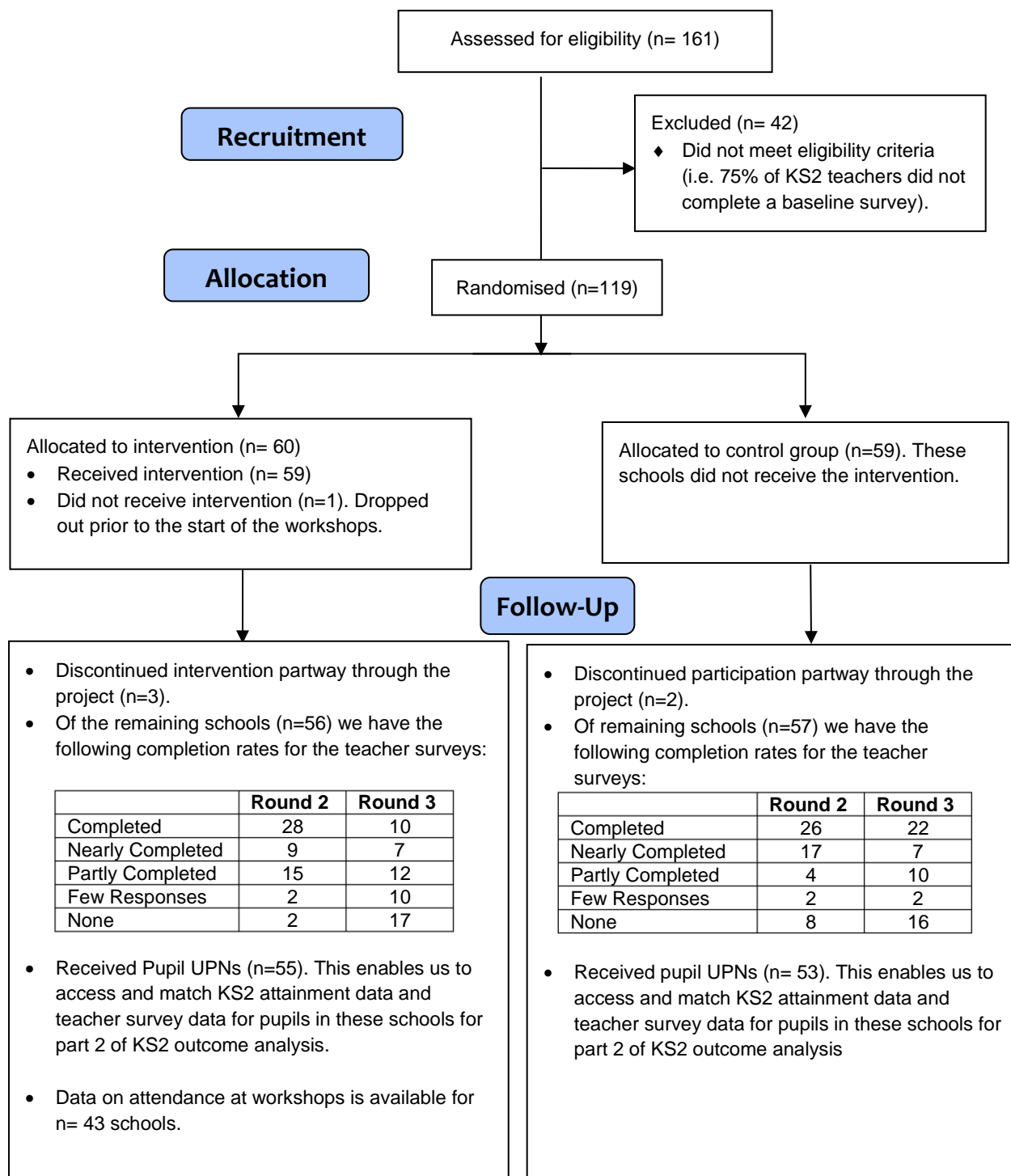
- Schools will be allocated in equal proportions to the treatment and control condition.
- There will be a baseline covariate of KS1 literacy, for KS2 literacy outcomes, at 0.73 correlation.
- An intra-cluster correlation of 0.2.
- Each group of 2, 3, 4 or 5 schools will be treated as one unit (this makes the calculation particularly conservative, as there is a lot of variation within each of these units). Individual schools will also be treated as a unit.
- An average of 50 pupils in the cohort per unit (again, this is conservative as some units comprise more than one school, and will have many more than 50 students in – even though some schools will be smaller than this).

With 70 units, the minimum detectable effect size is 0.18.

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[1]This can be downloaded from Sourceforge at: http://minimpy.sourceforge.net/

[2] Optimal Design Software for Multi-level and Longitudinal Research is available from: www.wtgrantfoundation.org.

6. Follow-up

Assessed for eligibility (n= 161)

Recruitment

Excluded (n= 42)
- ◆ Did not meet eligibility criteria (i.e. 75% of KS2 teachers did not complete a baseline survey).

Allocation

Randomised (n=119)

Allocated to intervention (n= 60)
- Received intervention (n= 59)
- Did not receive intervention (n=1). Dropped out prior to the start of the workshops.

Allocated to control group (n=59). These schools did not receive the intervention.

Follow-Up

- Discontinued intervention partway through the project (n=3).
- Of the remaining schools (n=56) we have the following completion rates for the teacher surveys:

	Round 2	Round 3
Completed	28	10
Nearly Completed	9	7
Partly Completed	15	12
Few Responses	2	10
None	2	17

- Received Pupil UPNs (n=55). This enables us to access and match KS2 attainment data and teacher survey data for pupils in these schools for part 2 of KS2 outcome analysis.

- Data on attendance at workshops is available for n= 43 schools.

- Discontinued participation partway through the project (n=2).
- Of remaining schools (n=57) we have the following completion rates for the teacher surveys:

	Round 2	Round 3
Completed	26	22
Nearly Completed	17	7
Partly Completed	4	10
Few Responses	2	2
None	8	16

- Received pupil UPNs (n= 53). This enables us to access and match KS2 attainment data and teacher survey data for pupils in these schools for part 2 of KS2 outcome analysis

7. Outcome measures

7.1   Primary student outcome

The primary student outcome measure will be 2016 KS2 attainment data in Reading (this data relates to the NPD intention to treat cohort of pupils who were in Year 5 at the start of the intervention). This will be accessed via the National Pupil Database. Our understanding is that the DfE will be providing these test results as a scaled score ranging from 80 to 120.

7.2   Secondary student outcome

The secondary outcome measures will be the 2016 KS2 attainment data in Mathematics and KS2 attainment data in Grammar, Punctuation and Spelling. Based on our present understanding of the data format, we will be using pupil scores in the KS2 Mathematics test and pupil scores in the KS2 Grammar, Punctuation and Spelling test, which are presented as scaled scores ranging from 80 to 120.

7.3   Secondary teacher outcome

Other secondary outcome measures will come from the Round 2 and Round 3 teacher surveys which assess teachers' awareness, understanding and use of research. These include six distinct summary outcome measures for each teacher respondent and each administration of the teacher survey:

- Positive disposition to academic research in informing teaching practice;
- Use of academic research to inform selection of teaching approaches;
- Perception that academic research is not useful to teaching;
- Perception that own school does not encourage use of academic research; and
- Active engagement with online evidence platforms;
- Knowledge of research findings and methods.

These six summary measures are defined by NFER and are used across all EEF research use evaluation projects.

8. Analysis

Analysis of Student Outcomes

There will be two parts to the analysis of pupil attainment 2016 KS2 outcome data (in both parts using the 2015 Year 5 intention to treat cohort sample):

Part 1 uses multi-level modelling (MLM) to determine the effect size of the impact of the intervention on pupil attainment in Reading (primary outcome) and Numeracy and Grammar, Punctuation and Spelling (secondary outcomes) at KS2, accounting for clustering of pupils within schools (in random part by allowing random variation across schools) and of schools within RLCs (in fixed part by using a dummy variable for each RLC). We will also include in the fixed part of the model: a dummy variable for intervention group, and prior KS1 attainment (from the NPD database), FSMever eligibility dummy variable (from the PLASC/School Census) and relevant dummy variables for each of the variables used for the school randomisation (size in three categories (low/medium/high); %FSM in two categories (low/high); 2013 KS2 attainment in two categories (high/low)) as covariates. Part 1 will not include or be linked to the teacher survey data, but will be a separate, stand-alone analysis.

Part 2 involves linking individual teacher questionnaire data (from Round 2 of the survey) with pupil KS2 attainment data, using combined Year 5/6 teacher name/student name UPN class lists provided by the schools. For each pupil, six mean Year 5/6 teacher survey variables (reflecting different levels of teacher awareness, understanding and use of research - see section 7.3 above) will be created from averaging the Round 2 survey responses of their specific Year 5 and Year 6 Teachers. Multi-Level Modelling will be used to understand whether different levels of teacher awareness,

understanding and use of research can explain or are related to differences in pupil attainment at KS2. The clustering of pupils within teachers/classes and schools and schools within RLCs will be taken into account using the same approach as in Part 1. The outcome variable for this will be 2016 KS2 attainment in Reading (for the 2015 Year 5 intention to treat cohort sample as in Part 1). Round 2 of the survey will be used because teachers' research use as indicated by the Round 2 survey is more likely to be reflected in their teaching the following year which will lead up to the KS2 SATs assessment for the cohort of interest – and therefore may bear some relationship to pupil outcomes. Round 3 of the survey is collected 6 weeks or more after the SATs, and would probably not be a good reflection of how teachers have taught over the previous 2 years leading up to the measurement of pupil outcomes. Changes that may have taken place in teachers research use in between Round 2 and Round 3 of the survey (as measured by the Round 3 survey) would be unlikely to have fed through into their teaching practice and from there into pupils' learning.

Analysis of Teacher Outcomes

The survey analysis will use multi-level modelling (MLM) to determine the effect size of the impact of the intervention on each of the six summary research engagement outcome measures (see section 7.3 above) also taking account of the nesting of teachers within schools within RLCs. The six teacher outcome measures will be calculated for each teacher respondent using the Round 3 teacher survey. Teacher type variables (e.g. Evidence Champion, KS2 teacher attending RLC workshops, other KS2 teacher, other teachers) will also be explored as a potential explanatory variable for use in the MLM analyses. A separate analysis will consider whether teacher responses to the survey change from Round 2, after the first year of the intervention, to Round 3, after the second year of the project, where schools will be more independent in leading the RLCs.

The analyses detailed above will be conducted using MLwiN software[3]. Due to the nature of the project and survey responses it will be impractical to conduct the analysis blind to group identity.

Imbalance at baseline

No imbalance is anticipated for the KS2 outcomes analysis (Part 1) because this data comes entirely from Year 5 intention to treat NPD records.

For the KS2 outcomes analysis (Part 2) and teacher outcomes analysis, the baseline characteristics of the pupils and schools lost to follow-up (or not providing valid UPN/teacher survey data) and those included in the final analysis will be reported separately to identify the effect of attrition on the original sample as a whole. Descriptive statistics will be compared on the original control and treatment samples and analysis samples to identify whether there are any significant differences on key variables (KS2 attainment and FSM eligibility).

Missing Data

No missing data is anticipated for the KS2 outcomes analysis (Part 1) because this data comes entirely from Year 5 intention to treat NPD records. Part 1 analysis will be based on the full cohort of KS2 students in the NPD for participating schools.

For the KS2 outcomes analysis (Part 2), the main source of missing data is via missing pupil UPNs and missing data on school engagement (measured through attendance at workshops) which cannot be imputed (see section 6 for more details). Otherwise we are not expecting any significant missing data on key analysis variables (KS1 and KS2 pupil attainment, and Free School Meals eligibility).

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[3] MLwiN Version 2.02 – Available at Centre for Multilevel Modelling, University of Bristol - http://www.bristol.ac.uk/cmm/software/mlwin/

For the teacher outcomes analysis, the extent of missing item data will be examined and its effect on the calculation of the 6 summary measures.

<u>On-treatment analysis</u>

In addition to the analysis to determine the effect size of the impact of the intervention on pupil KS2 attainment (described in Part 1 of the student outcome analysis above), an additional analysis will also use the level of school engagement with the programme as a covariate in the same analyses of each student attainment outcome. This variable has been measured by the attendance records of Evidence Champions at eight workshops that took place over the two years of the project. Each workshop was either attended by 0,1 or 2 Evidence Champions providing us with a variable ranging from 0 to 16 for each treatment school. This variable effectively describes the extent of intervention 'dosage' and will provide additional evidence on the strength of the intervention impact.

<u>Sub-group Analyses</u>

Separate sub-group analyses will also be conducted for Part 1 of the student outcome analysis above. This will consider FSMever/non FSMever groups and schools' choice of focus in the workshops at the beginning of the project (literacy or numeracy) as well as the interaction of these sub-groups with intervention group. This analysis will use the final model to determine the effect size of the impact of the intervention on pupil attainment for sub-groups.

<u>Effect size calculation</u>

The effect size will be calculated in line with EEF guidance. This involves using the total variance after adjusting for prior attainment, FSMever, and other covariates described in part 1 above. This will be calculated using the random part estimate (pupil-level) from the final MLWIN model. All outcome and baseline attainment variables will be standardised using normal scores. The effect size will be represented by:

(Coefficient for treatment group)/√(total variance after controls).

The confidence interval will be calculated using fixed part estimate for intervention dummy +/- 1.96xSD

9. Report tables

Table 1: Summary of impact on primary outcome

Group	Effect size (95% confidence interval)	Estimated months' progress	EEF security rating	EEF cost rating
Treatment vs. control				
Treatment FSM vs. control				

Table 2: Minimum detectable effect size at different stages

Stage	N [schools/pupils] (n=intervention; n=control)	Correlation between pre-test (+other covariates) & post-test	ICC	Blocking/ stratification or pair matching	Power	Alpha	Minimum detectable effect size (MDES)
Protocol	110 (55:55) OR 70 Units	0.73	0.2	Did not use in calculations	0.8	0.5	0.16 OR 0.18
Randomisation	119 schools (60:59) OR 71 units	0.73	0.2	Did not use in calculations	0.8	0.5	0.18
Analysis (i.e. available pre- and post-test)	119 (60:59)	0.73	0.2	Did not use in calculations	0.8	0.5	0.18

Table 3: Baseline comparison

Variable	Intervention group		Control group	
School-level	n/N (missing)	Mean	n/N (missing)	Mean
Size of School	60/119 (0)	319.2	59/119 (0)	341.1
Pupil-level	n/N (missing)	Percentage	n/N (missing)	Percentage
FSM Eligibility	60/119 (0)	20.7%	59/119 (0)	22.0%
Attainment at KS2 (% achieving level 4 in reading, writing and maths)	60/119 (0)	79.3%	59/119 (0)	75.8%

Table 4: Primary analysis

	Raw means				Effect size		
	Intervention group		Control group				
Outcome	n (missing)	Mean (95% CI)	n (missing)	Mean (95% CI)	n in model (intervention; control)	Hedges g (95% CI)	p-value
KS2 attainment in Reading							