

Protocol for Evaluation of Edge Hill University Intervention 1stClass@Number

Evaluation Summary	
Age range	Year 2 (age 6-7)
Number of pupils	Around 480 (240 in intervention group)
Number of schools	120 (4 pupils per school)
Design	Cluster randomised trial
Primary Outcome	Mathematical Reasoning Test (Nunes & Bryant)

BACKGROUND

Intervention

This evaluation will test the impact on student outcomes of the programme *1stClass@Number*, which is an intervention designed by Edge Hill University. The programme aims to support children in Year 2 who have difficulty in mathematics. The intervention is delivered by specially trained teacher assistants (TAs) to small groups of 4 children who, at the start of Year 2, are judged by their teachers as having difficulties accessing the Year 2 curriculum and may benefit from taking part in *1stClass@Number*. TAs receive six sessions of professional development and deliver five topics of six half-hour lessons each (a total of 30 half-hour sessions), normally 3 times a week over approximately 10 weeks. These sessions are in addition to usual, daily classes of mathematics. These sessions usually take place at different times to avoid children missing always the same class. In this RCT, the sessions will be offered during term 1 of Year 2. These lessons focus on core aspects of number in the National Curriculum (number sense, place value and calculation) and take a playful approach, using a Post Office theme. The intervention includes formative assessments and detailed lesson plans.

Significance

The current widespread use of *1stClass@Number* and the efficacy of a similar intervention, Numbers Count, which is delivered by highly trained teachers rather than by TAs, indicate that *1stClass@Number* should be evaluated in an effectiveness trial.

RESEARCH PLAN

Research questions

The primary research question is:

- Do the children identified by their teachers as struggling with mathematics at the start of Year 2 who participate in the *1stClass@Number* intervention show greater gains in a test of quantitative reasoning than children identified by their teachers as struggling with mathematics at the start of Year 2 who do not participate in the intervention?

Secondary research questions:

- Do children entitled to FSM benefit equally as other children from the 1stClass@Number intervention as assessed by the quantitative reasoning test?
- Is the 1stClass@Number intervention as effective for girls and boys as assessed by the quantitative reasoning test?

Design

120 primary schools in the South and West Yorkshire will be recruited to participate in the RCT with two trial-arms, an intervention and a control group. Randomisation will be at school level; pupils who could benefit from the programme will be identified prior to randomisation (see details below). The design will include a baseline and a post-test of the children's performance in a measure of mathematical reasoning. All children in the schools recruited for the project will be assessed in the baseline measure at the end of Year 1, subject to parental consent. The baseline measure showed a correlation of .7 with the outcome measure when these were separated by a 12-months interval (Nunes, Bryant, Evans, & Barros, 2015), which is substantive enough for a covariate.

The unit of randomisation will be the school, as contamination could occur in schools even if there is more than one TA who delivers mathematics lessons to Year 2 pupils. The control schools will take a business as usual approach to supporting pupils who struggle with mathematics.

A briefing meeting will be held with all participating schools before randomisation. At the briefing meeting, schools will be reminded that they might be randomly assigned to the control group, in which case they should just do what they normally do, and not to do anything different just because they are taking part in the trial. The programme designers at Edge-Hill University will offer schools in the control group the option of participating in a similar mathematics or literacy programme for older pupils (Years 3 to 6).

At the briefing meeting, Edge Hill and Oxford will describe what is expected from schools. Edge Hill will instruct all participating teachers on how to select the four children as potential recipients of the intervention. All schools will nominate four pupils, who are considered by teachers to have fallen behind their peers and need additional support around the level of the Year 1 national curriculum for mathematics. At the end of Year 1, the teachers will administer the baseline measure for the project and will be able to use this information in making a decision about which pupils to nominate. Teachers are also advised to nominate for the same group children who can 'gel' and learn together and are not participating in another intervention, in order to avoid overload. Schools will nominate the children to Oxford University in September, before the random allocation; the information will be passed on to Edge Hill immediately after the randomisation is carried out. The written advice provided at the briefing meeting will also form part of the process evaluation for the trial.

Schools will also nominate for training a Teacher Assistant and a Link Teacher. Edge Hill's recommendation for the identification of a suitable TA is that the TA will:

- have successful experience of supporting children's mathematics
- be able to engage fully in training sessions that include the programme's procedures and the mathematics curriculum
- be able to make independent decisions while planning for and teaching children, based on an understanding of their needs and with the support of a Link Teacher.

Guidance in the identification of the Link Teacher is also provided. Edge Hill recommends that the Link Teacher should be someone who will:

- provide the strategic leadership for the programme
- be suitably experienced to give support with the teaching of mathematics
- have time to support the teaching assistant and liaise with the class teacher(s), senior managers, SENCo, and other professionals as necessary
- attend two half-day training sessions with the teaching assistant.

It is recommended that the Link Teacher is a senior member of staff. If the school prefers to nominate a class teacher who will liaise closely with the teaching assistant, then a senior manager can provide the leadership and additional support that will maximise the impact of the intervention.

The trial will be designed, conducted and reported to CONSORT standards and adhering to Ethics and data protection from the Oxford University Ethics Committee. It has been approved by the Central University Research Ethics Committee.

Participants

School recruitment will be carried out by the 1stClass@Number team. Only schools that have never participated in 1stClass@Number will be eligible to participate in the trial.

At the briefing meeting, schools will receive instructions on how to implement a pre-test provided by the evaluation team to all children in Year 1. Teachers will implement the test in their classes prior to randomisation, thus without knowledge of whether their pupils will participate in the intervention or not. Schools will obtain parental consent for participation in the trial and teachers will administer the test in May 2016. The parental consent letter is included in Appendix 1. Only children who answered the pre-test will be eligible for nomination to participate in the 1stClass@Number intervention. The evaluation team will return the results of the pre-tests to the schools in September. Teachers may use this information alongside the guidance provided by Edge Hill to identify pupils for the trial. Schools will, at the same time, nominate to Oxford University and Edge Hill the TAs and link teachers responsible for the intervention, if the school is allocated to the intervention group. Edge Hill will not indicate the criteria for the nomination of TAs and link teachers, above and beyond their commitment to participate in the training and to deliver the intervention faithfully. The agreement between the schools and Edge Hill is included in Appendix 1.

Randomisation

After the list of children has been provided to the evaluation team, the schools will be randomly assigned either to an intervention or to a control group by the evaluation team, with an equal allocation of schools to each group.

Four geographic clusters were identified so far after schools registered their interest to participate in the trial. Schools in each geographic cluster will be split in two blocks using the median for the number of children eligible for pupil premium, generating 12 blocks. Random allocation will be within these blocks, with an equal allocation of schools to each group, intervention or control. The description of these blocks at this stage is presented in Appendix 2; changes may take place if schools drop out or join the trial before randomisation.

Outcome Measures

Children's attainment

The Mathematical Reasoning Test, developed by Nunes and Bryant, will be the primary outcome measure (Nunes, Bryant, Barros, & Sylva, 2012). It shows high and significant correlations with KS1, KS2 and KS3 mathematics achievement, after controlling for general intelligence and working memory. The test is delivered as a whole class assessment with the support of a PowerPoint presentation, which allows the tester to verify that all the children are looking at the same item. Items are illustrated by drawings and standardised instructions are provided. The test includes items that relate to children's understanding of place value, additive and multiplicative reasoning, which are among the explicit aims of the 1stClass@Number intervention, and does not show floor or ceiling effects for this age level. Items of the pre- and post-test will vary according to levels of difficulty but some items overlap, which allows for a measure of progress.

A secondary outcome measure will be Key Stage 1 maths outcomes, considering that the intervention aims to promote pupils' knowledge of topics included in the National Curriculum.

Pre-tests will be carried out prior to randomisation by teachers, who will receive detailed instructions for implementing the assessment from evaluators at Oxford University. Post-intervention testing will be administered by researchers from the evaluation team, blinded to the school's group allocation. A protocol has been developed to train the testers on how to approach the schools without identifying their group membership, to standardise testers' initial approach to the children and ways of providing clarification if children ask questions, and to anonymise the tests before they are posted to the evaluation team. The latter procedure was approved by the Oxford University Ethics Committee.

Sample size calculations

The aim is to have power to detect an effect size for intervention relative to control of at least 0.22 SD, which seems reasonable given the previous evaluations of Numbers Count (ES=0.30), the similar programme delivered by teachers. We used Optimal Design software and made the following assumptions: (i) pupil outcomes measured at pre-test and at post-test have a correlation of $r=0.70$ at pupil level; (ii) a within school sample of 4 pupils per school; (iii) an intra-class correlation coefficient of 0.15; (iv), power of 0.80, alpha of 0.05 and a 2 tailed significance test. A sample of 60 schools per trial arm (120 schools in total) would yield approximately 480 children in total giving 80% power to observe an effect size of 0.22 SD. It is advisable to recruit 130 schools in case there are drop-outs after randomisation.

Analysis plan

Pupil performance in the Mathematical Reasoning Test at post-test will be the primary outcome. Secondary analysis will be done using maths KS1 scores. Analyses will be conducted in SPSS/MLwiN using 2-tailed significance tests at the 5% significance level. ANCOVA will be used to compare intervention and control groups on the post-test scores, controlling for pre-test scores; a two level model (pupils within schools) will be used to account for possible clustering at the school level.

The design will use intent to treat and analyses will include the maximum number of participants. Reasons for missing data will be investigated and if a high number is observed, possible biases will be investigated. Effect size will be calculated using ANCOVA controlling for pre-test scores, to increase precision and power. Hedge's g will be used to indicate the effect size and will employ the appropriate total pupil variance from the ML model; the confidence interval will be reported using the traditional 95% interval. The intra-cluster correlation will be reported for pre- and post-test. The details of the model will be reported.

Subgroup analysis

Schools will be asked to provide pupils' date of birth, gender and Unique Pupil Number (UPN) for matching with data from the NPD, which contains information on entitlement to a Free School Meal (FSM) with EverFSM being the preferred specific indicator. A separate analysis will be completed in to test for the interaction between treatment and EverFSM, and treatment and for Gender. The analysis will test for the interaction between treatment and each of the subgroups. Analyses within these subgroups will be carried out but the results must be taken with caution as the number of children and schools will be reduced, which will have an impact of effect size and significance.

Process evaluation methods

The focus of the process evaluation will be to assess the fidelity of the programme and to understand what business as usual in the control schools means.

Research questions to be addressed by the evaluation

The main research question to be addressed by the process evaluation is:

- Does fidelity to treatment moderate the effectiveness of the 1stClass@Number intervention?

A secondary research question to be addressed is:

- Does the use of alternative treatments in the control schools involve the same contents and the same amount of resources as in the intervention schools?

Different sources of data will be used in this analysis. Some information will refer to the TAs' ability to deliver quality lessons to struggling learners. Even when someone is using a highly scripted intervention, it is necessary to be able to follow the child's answers and select procedures that are contingent upon the answer. Other relevant information refers to the content and sequence of the lessons: are TAs implementing all the 1stClass@Number intervention activities and in the appropriate order? Does the content of these activities differ sufficiently from the content used in the control schools for the intervention to show an impact? Finally, interventions take place in a context, and TAs must be given the necessary resources (time for delivery and for preparation; time for consultation with the link teacher; adequate working space) in order for the intervention to succeed.

The following activities summarise the data collection for the process evaluation:

1. *Description of 1stClass@Number training and development of a logic model/theory of change*
This will involve attending the 1stClass@Number training to understand the content of the intervention. It will also include a theoretical analysis of the content and of the approach of the materials, as well as observation of a sample of sessions delivered by TAs. The aim is to make implicit assumptions explicit, going beyond the explicit guidance provided in the project materials. Our model will be discussed with the project team before it is used during observations. This information gathering will inform the analysis of whether TAs are delivering the intervention as scripted and focusing on the contents highlighted in the training.

2. *Surveys, lesson observations and interviews (TAs and link teachers)*
A significant amount of valuable process data can be gathered using questionnaires and observations to obtain quantitative information on organisational and management strategies (e.g. clarity of aims for the lesson; planning and ensuring that all materials are available; time on task; coping with range of attainment; school organisation aspects, such as timetabling of lessons, allocation of preparation time for TAs, meetings with link teachers and class teachers).

All TAs will be asked to complete the questionnaires, which will contain information on implementation and pupil attendance. These will be completed for each session, thereby minimising the amount of information to be recalled and recorded at any time.

A sample of 1stClass@Number lessons (n=10) will be observed to gather data on implementation and fidelity, quality of teaching and child engagement. TAs will be selected randomly; five lessons will be observed after the 3rd training session, which gives TAs time to settle in the use of the programme, and another set of five towards the end of the programme. Because the training is carried over six sessions, observation of initial lessons may be less informative about the process, as the lessons will be focused on a single topic.

Interviews will be conducted over the phone with a sample of intervention (n=10) and control (n=10) link teachers to provide relevant data for the process evaluation (e.g. what activities are in place to support Year 2 children mathematics learning, what resources are used in the classroom, whether children have one-to-one or small group supplementary instruction, and what programmes are used with them). It can be reasonably expected that, after identifying children that need extra support, control schools will aim to offer some extra support as part of their deployment of TAs. There are several schemes available for use with children who have mild mathematics difficulties; documenting their use would be hugely important in describing

what "business as usual" means. In the intervention group, data will be collected also on replacement of the TA initially trained and how this was dealt with, if applicable.

3. *Survey of link teachers*

A questionnaire will be developed to assess how intervention and control schools worked with the pupils identified as eligible for the intervention as well as their general approach to supporting children struggling with mathematics. This questionnaire will collect data on implementation of the programme in intervention schools and on whether control schools carried out anything different from previous years, as it may be part of their continued professional development to learn and use new approaches to mathematics teaching. It is noted that a new mathematics assessment has been developed for Key Stage 1. A sample paper is available on line; its organisation in two parts, reasoning and arithmetic, is new and could affect the way schools prepare children for this assessment.

Separate rating scales for different aspects of fidelity as recorded by TAs and the Link Teachers in response to the survey will be composed, including (1) TAs attendance at training; (2) space and time resources; (3) children's attendance; (4) TAs' records of preparation time and meetings with Link Teacher; (4) TAs' records of activities carried out in sessions (indicating whether all activities were implemented and in the order expected). The psychometric properties of these scales will be analysed and, if appropriate, an overall measure of fidelity will be composed. This will be used as the moderator in the analysis of fidelity with respect to outcomes.

Observations and interviews cannot be used quantitatively as the number is limited; qualitative analysis will provide information on how the TAs coped with range of abilities and the use of tasks contingently to the children's answer.

Comparisons between type of support offered in the intervention and control schools will be carried out by considering the frequency with which topics that integrate the 1stClass@Number intervention are taught to children in control and intervention schools (e.g. how often do control schools refer to teaching the children about place value?).

Costs

Cost data will be gathered from the 1stClass@Number team and from the sample of schools visited for observations using a questionnaire. Data will include training costs, resources, staff time spent on training and on delivering the intervention, number of staff trained, hours spent on training, costs paid by the school in order to run the intervention, expenditure for material and salary costs. Information on the planned use of the intervention after the trial will be collected to inform the effectiveness of use of resources.

Costs provided by EHU include annual school cost and cost per pupil, including all training costs, resources, and staff time for 4 groups of 3-4 pupils over 2 years. Data provided by EHU and schools will be consolidated to provide overall cost estimates.

ETHICS AND REGISTRATION

Ethics approval has been obtained by the evaluation team from the Ethics Committee in the University of Oxford. It is expected that data from this project will be linked to the NPD; although an opt-out letter can be used, explicit consent to link the pupils' data collect for the project to the NPD was added to the consent form.

As soon as appropriate, the trial will be registered at The International Standard *Randomised Controlled Trial* Number (ISRCTN) <http://www.isrctn.com/>

Data Protection

The University of Oxford Ethics Committee has a data protection policy that can be found at: http://researchdata.ox.ac.uk/files/2014/01/Policy_on_the_Management_of_Research_Data_and_Records.pdf

PERSONNEL

Project team: The project will be led by Nick Dowrick and Louise Matthews (Edge Hill University).

Evaluation team: Terezinha Nunes and Rossana Barros (University of Oxford) will oversee all the aspects of the evaluation. Maria Evangelou will contribute with aspects of ethical approval and the process evaluation; Steve Strand will participate in the data analysis and be a critical reader; Sandra Mathers will participate as a critical reader.

EEF team: Camilla Neville and Matthew van Poortvliet will oversee the whole grant.

Roles and responsibilities

Each person will carry out their duties with the assistance of teams at their respective institutions.

1stClass@Number (Edge Hill University): will carry out the recruitment and provide record of recruitment steps, give training and provide record of training attendance, delivery of intervention, supply list of eligible schools for randomisation, supply factors for success, supply information on costs, and facilitate the access and communication of the evaluation team with the schools.

Evaluation team (Oxford University): their role includes trial design and registration, obtaining ethical approval from Oxford University, supporting the Project team in preparing letters and information for schools and attending briefing events; preparation and distribution of parental consent letters, test preparation, administration, distribution, collection, and marking of pre and post-tests, as well as informing schools of pre-test results; obtaining class lists and the nomination of selected children from schools; randomisation; liaising with DfE for NPD; carrying out analyses and writing the report and publications; carrying out process evaluation observation visits, surveys and interviews, and analysing these.

The evaluation team is committed to providing the 1stClass@Number team with information about when communications with the schools will be established, what the contact people in the schools will be asked to do, and how they will be contacted. Any unexpected reactions would be reported immediately to the 1stClass@Number team and the ways to maximise continued cooperation in the particular school would be agreed. The evaluation team is aware of the resources restrictions in schools and of the need to minimise the burden placed on administrators and teachers.

RISKS

Issue	Likelihood of risk	Mitigating Actions
Difficulty or delays in recruiting schools and consequently TAs and children	Moderate	Friendly and clear material that will explain the design and value of the study; follow up phone calls and visits to settings as personal contact is best in case of reluctant settings. The team is very experienced in working with primary schools and ensuring a high participation rate.
TAs or pupil attrition	Moderate	Very clear information to be offered to schools explaining the evaluation design, their involvement and the expectations. The team is very experienced in working with primary schools and ensuring a high participation rate.
Control practitioners and children exposed to elements of the intervention or to variation from 'business as usual'	Low	During the process evaluation activities of both groups (intervention and control) will be monitored to show if there is any contamination; although the risk is not avoided, it can be recorded and considered in the quality of the trial.

Delays in commencing the delivery of the intervention	Medium	Agree a clear timetable with the intervention team; be flexible as much as possible in revising the timings of pre and post testing.
Poor completion of questionnaires by TAs regarding teaching	Low	The team is very experienced in working with TAs and primary school teachers and will seek to make the assessment process accessible and a valuable experience for all involved.
Researchers lost to project due to sickness, absence or change of	Low	The team is able to recruit fairly quickly. The majority of the team members has permanent positions and expertise in different aspects required for this project.
Children's attendance may vary and may affect the intervention dose	Medium	Collect data on children's attendance; although the risk cannot be avoided, it can be recorded and considered in the quality of the trial.

TIMELINE

Date	Activity
Sep 2015-March 2016	Develop and register protocol at http://www.isrctn.com/
Oct 2015 – Apr 2016	Recruitment of schools
May 2016	Briefing event for all schools
June 2016	Pre-test and initial identification of target pupils by schools
September 2016	Selected pupils and staff confirmed followed by randomisation
Sep –Dec 2016	Training of TAs and delivery of intervention 1 st Class@Number. Evaluation team to carry out observations for assessment of fidelity.
June 2017	Post-test and survey of link teachers.
Jul – Oct 2018	Data Analysis of test data
Nov 2017 – Jan 2018	Data Analysis follow up with National Pupil Data
Feb – Jun 2018	Final Report to EEF, publications and dissemination of results.

REFERENCES

- Nunes, T., Bryant, P., Barros, R., & Sylva, K. (2012). The relative importance of two different mathematical abilities to mathematical achievement. *British Journal of Educational Psychology*, 82(1), 136-156.
- Nunes, T., Bryant, P., Evans, D., & Barros, R. (2015). Assessing Quantitative Reasoning in Young Children. *Mathematical Thinking and Learning*, 17(2-3), 178-196. doi: 10.1080/10986065.2015.1016815