# Maths for Life
**The Behavioural Insights Team**
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Evaluation Summary

| Age range | FE College Students |
|---|---|
| Number of pupils | Around 400 |
| Number of settings | 20 |

**This document outlines the proposed methods to understand if the Maths-for-Life intervention is ready to be trialled at the efficacy level.**

**Summary**
The MathsforLife intervention is a professional development programme aimed at improving student engagement and efficacy for those resitting their examination in college. Delivered by the Centre for Research in Mathematics Education of the University of Nottingham **it** aims to improve attainment by supporting teachers to deliver GCSE resit classes in ways that are more student-centred and focused on problem solving and dialogic teaching. It one of three post-16 trials funded by a partnership between J.P.Morgan and the Education Endowment Foundation.
The first year of the study will be a pilot, to understand if the programme is ready for trial. This document outlines our proposed methods for the research we will conduct to ascertain if the pilot is ready for trial.

For the research, we will use a convergent parallel mixed method design, where data are collected formatively across the year and triangulated during the final analysis phase. This will enable the findings from one source of data to be confirmed or refuted by the other sources of data. These will be as follows:
- Self-report survey with teaching staff who helped develop the training
- In-depth interviews with students, teachers and SLT
- Observations of intervention, including training and delivery in schools

With a focus on feasibility, evidence of promise and participant experience, we will work with the delivery team to refine the pilot so it is of maximum benefit. In early April 2018 we will present these findings to the EEF. In addition, an on-going dialogue between the delivery team and evaluation team will be established to provide timely feedback from the pilot.

This work is part of a specific round looking at post-16 education which is being co-funded with JPMorgan Chase as part of their commitment to expanding the technical and professional education of young people to expand access to economic opportunity.

**Intervention**

**Background**

The Maths-for-Life intervention supports improvement in GCSE mathematics retake pass rates for post-16 students by developing a more student-centred classroom approach based on problem solving and dialogic teaching. Typically tasks are designed to be used with students working collaboratively. For example, students could be given a set of cards with different objects on (a tall skyscraper, the length of a fly, the distance to the moon) and asked to work in groups to match each object to their corresponding measurement.  The intervention builds on an evidence based corpus of classroom materials, developed over a substantial period by Centre for Research in Mathematics Education at Nottingham (see e.g. mathshell.org)[1]. The materials to be used are targeted specifically at GCSE resit students and post-16 students more widely. The materials address key mathematical areas and concepts (e.g., number, ratio, algebra) using contexts and problems designed to re-engage this group of students in mathematics. Many of these students experience disaffection and disengagement after "failure" at school maths and GCSE. The intervention addresses this by introducing a problem-solving approach, adopting a student-centred focus, centred around discussion and research-informed diagnostic and formative assessment. As a result, students experience mathematics as different and more engaging compared to "school" maths. The intervention supports teachers by providing high quality evidence-informed materials together with a professional development (PD) programme based on Wake and Swan's lesson study research[2]. The PD takes an "action research" approach led by a cadre of trained teacher PD Leads in which teacher research groups engage in five cycles of carefully focused classroom based inquiry into effective pedagogies supported by an online toolkit.

The programme, which is yet to be manualised, divides into two phases.

Phase 1: Nottingham works and trains fifteen- twenty teachers to develop and trial the PD programme, updating existing resources from the LeMaPS toolkit[3]; explicitly define the programme and develop a system to cascade the programme with fidelity.

Phase 2: Scale the programme across 80 settings in a randomised controlled trial. The 20 teachers from Phase 1 deliver the PD programme.

The evidence for the principles behind the programme is best described in a number of publications by Malcolm Swan the lead designer and researcher of the materials on which the intervention is designed[4]. Fundamentally the teaching resources draw on design principles drawn from diagnostic teaching research. Swan reports evidence that effective use of the materials in student centred ways in post-16 contexts leads to increases in attainment. The study used a pre/post test design to assess the outcomes of students (N=334) who received 'many' or 'few' of the

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[1] Swan, M. (2006). Learning GCSE mathematics through discussion: what are the effects on students?. *Journal of Further and Higher Education*, *30*(3), 229-241.; Swan, M. (2007). The impact of task-based professional development on teachers' practices and beliefs: A design research study. *Journal of Mathematics Teacher Education*, *10*(4-6), 217-237.; Swan, M., & Swain, J. (2010). The impact of a professional development programme on the practices and beliefs of numeracy teachers. *Journal of further and Higher Education*, *34*(2), 165-177.
[2] http://www.nottingham.ac.uk/research/groups/crme/projects/lemaps/index.aspx
[3] http://www.nottingham.ac.uk/research/groups/crme/projects/lemaps/index.aspx
[4] Swain and Swan 2007: http://dera.ioe.ac.uk/22296/1/doc_3631.pdf

lessons. Those who received 'many' had statistically significant gains on an algebra test compared to their peers who received 'few' (0.38 effect size). In adaptation of the materials for the US an evaluation used a quasi-experimental design (N=471) with a well-matched control group and found that the intervention group made significant gains in attainment compared to the control group (effect size d=0.13 which is equivalent to 4.6 months of schooling).[5] The approach primarily supports use of diagnostic-informed formative assessment and as such develops powerful classroom talk to stimulate and extend students' thinking and advance their learning and understanding. The PD will use a modified lesson study approach that impacts upon teachers' knowledge, beliefs and dispositions, the norms and routines of classroom practice as well as curriculum delivery.

**Pilot description**

The pilot year, phase 1, of the MathsforLife intervention will test and develop the resources and programmatic structure. It aims to do this by recruiting 20 teachers to work in appropriate clusters of 4-5 teachers around the UK. These teachers will help develop the materials and experience the professional development in the same format which will be adopted in the trial. These teachers will then become the 'lead' teachers should an efficacy RCT trial be feasible and be responsible for leading a cluster of newly recruited teachers who will experience the intervention.

The structure of the programme is as follows:

- 5 days will be used to trial the actual PD intervention in the classroom and 5 days will be used to refine and develop the materials
- PD is delivered to teachers in 5 sessions from September 2017-March 2018 - these consist of a half day of pedagogy training followed by half a day of reflection through a lesson study of the maths content and pedagogy.
- In the intervening period between sessions, the teachers will work with the approach drawing on materials that support this and that are supplied as part of the intervention.
- The lead teachers will also work with the delivery team to refine and help develop further the materials.

**Research questions**

The pilot aims to address three research questions, which hope to address the pilot's overarching purpose: *whether the intervention is ready for trail*:
1. **Evidence of promise** - does it appear that this intervention could improve GCSE attainment of FE learners?
2. **Feasibility** - can the intervention be delivered in a way that is effective for FE Colleges and FE maths teachers?
3. **Readiness for trial** – is enough in place to allow the intervention to take place the following year at scale (i.e. have enough participants been trained

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[5] Herman, J. L., Matrundola, D. L. T., Epstein, S., Leon, S., Dai, Y., Reber, S., & Choi, K. (2015). The Implementation and Effects of the Mathematics Design Collaborative (MDC): Early Findings from Kentucky Ninth-Grade Algebra 1 Courses. CRESST Report 845. *National Center for Research on Evaluation, Standards, and Student Testing (CRESST).*

to act as trainers, are the programme materials and training suitably defined and developed)? And are the data collection methods suitable, feasible and readily available?

**Methods**
**Recruitment**
All teachers who have been recruited and signed up by the University Nottingham will participate in the pilot study. . Through their Memorandum of Understanding we attain consent for their participation in the pilot.

Across each of the teacher clusters, we will randomly select a teacher to focus on in-depth, interviewing them, a member of SLT and a random selection of their students The teachers provide a list of pupils by ability, a sample of which are selected by the research team to interview.  Informed opt-out consent will be sought from the FE Learners (over 16 years of age) via their teachers.

**Data collection**

| Research Question | Metrics | Methods |
|---|---|---|
| **Evidence of promise** | 1. Materials positively received by at least 60% of students<br>2. 60% Teachers feel the PD can lead to improved outcomes for students<br>3. 60% teachers feel it has positively affected their practice?<br>4. 50% of students interviewed make positive comparisons between the PD lessons compared to their prior experiences<br>5. 30% of students make improvements in mathematical self-efficacy using the Pampaka scale. | • 4 Qualitative case studies per cluster (observation of lesson, interviews with teachers and a selection of students)<br>• Endpoint survey of teachers |
| **Feasibility** | 6. 60% teacher believe they are able to cascade the PD to teachers and students.<br>7. 60% teachers feel that the structure of cascading the PD, including timing of training, is fit for purpose.<br>8. Most (3/4) SLT feel the PD is beneficial relative to cost time/release for their setting and an average FE institution.<br>9. 60% teachers feel the programme is good enough to be delivered by non-maths specialists?<br>10. 60% of non-pilot FE colleges believe that the intervention is of value and would likely take up the intervention if it were offered | • 4 Qualitative case studies (interviews with SLT, teachers and a selection of students)<br>• Endpoint survey of teachers<br>• Observation of training<br>• Short interview with 4-5 FE Colleges not involved in the pilot |

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|---|---|---|
| **Readiness for Trial** | 11. 15 teachers have been trained and are willing to act as trainers in the next academic year<br>12. 60% of participating teachers feel that the programme materials and training suitably defined and developed | • Endpoint survey of teachers |
| **Piloting methods** | 13. Teachers can successfully administer the Pampaka tests to their students<br>14. Transmissionist teaching measures can be effectively captured in a survey. | • Survey to students (Pampaka) in the four classes of the case study<br>• Transmissionist survey to teachers |

**Observations**

We will observe two training sessions from different clusters at two time points (November 2017 and March 2018), this will help us understand how the materials are being created, delivered and received.

**Case studies**

We will conduct four case studies each featuring one randomly selected teacher, their SLT (metric 7) and their students from each cluster (metrics 1 and 4). This will consist of semi-structured interviews and an observation of a Maths-for Life lesson if feasible. This will take place in February 2018.

**Non-Pilot Interviews**

We will conduct short 10 minute interviews with 4-5 colleges who are not part of the pilot. These will be sampled randomly from another study we are running for the EEF, Study Supporter[6]. We feel this intervention is suitably different to provide a more neutral position on the intervention.

**Pampaka Scale**

The case study teachers will be asked to deliver the Pampaka scale to their students in October 2017 and in February 2018.[7]

**Survey**

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[6] https://educationendowmentfoundation.org.uk/our-work/projects/texting-students-and-study-supporters/
[7] http://www.teleprism.com/surveys.htm

A short online survey will be conducted with all 20 at the end of the pilot period. Using the insights from the qualitative interviews it will explore the perceptions of the programme and understand if themes from the case studies are generalizable beyond the context they occurred within.

**Transmissionist Teaching Questions**
Additionally, we will conduct a short online survey at the beginning of the trial to capture the transmissionist teaching style of the teacher. See appendix for survey questions. [8]

**Ethics and registration**
We will seek informed opt-out consent for students involved in the trial - the teachers will take responsibility for this.  Teachers will consent to participate as part of their memorandum of understanding when recruited by Nottingham University.
For detailed information on how we protect data, please refer to our security policy in annex 1.

**Personnel**
**Evaluation Team**
- Jessica Heal - Pilot evaluation and IPE
- Patrick Taylor – Pilot evaluation and IPE
- David Nolan - Pilot evaluation and RCT Impact Evaluation
- Pantelis Solomon - RCT Impact evaluation
- Louise Jones - Evaluation coordinator

**Delivery Team**
- Geoffrey Wake - Lead on Maths-for-Life
- Matthew Woodford – Maths-for-Life
- Peter Henderson - Project lead

**Risks**
This section outlines the risks to the pilot we anticipate may arise and steps we are taking to mitigate against these.

| Risk | Mitigation |
|---|---|
| Schools are unable or unwilling to either administer new assessments, and/or provide background/ demographic information on pupils. | Consider practicability as an important criterion in choice of assessment tools and data collection design. (Use extant sources of data – e.g. national pupil database) if possible. |
| Teachers are unwilling to participate in research | Oversampling strategies, and asking for a minimum of 4 out of a possible 20 teachers will increase our chances that we will find |

[8] Pampaka, M., Williams, J., Hutcheson, G., Wake, G., Black, L., Davis, P., & Hernandez-Martinez, P. (2012). The association between mathematics pedagogy and learners' dispositions for university study. *British Educational Research Journal*, *38*(3), 473-496.;
Pampaka, M., & Williams, J. (2016). Mathematics teachers' and students' perceptions of transmissionist teaching and its association with students' dispositions. *Teaching Mathematics and its Applications: An International Journal of the IMA*, *35*(3), 118-130.

| | consenting participants. It will also be part of the MoU signed by teachers when they sign up to participate in the study. |
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| Students opt-out of participating in research | In the case that students opt-out of participation, observations will take place of the teachers delivering the materials to understand how students engage in the lessons. |
| Teachers fail to provide data on time to the evaluation team. | If the teachers have difficulties collecting data in the baseline data collection stage, we will move the March data collection date forward by 1 month to ensure the data are collected in time to feed into the April reporting. |

**Timeline**

| Date | Activity |
|---|---|
| September 2017 | Training commences. Those who don't asked to administer before October. Four case study teachers randomly selected from each cluster. |
| October | Conduct Pampaka baseline in 4 case study classes. Teachers complete 1st transmissionist survey. |
| December 2017 | Observation of third training session. Interview non-pilot schools. |
| January-February | Qualitative Case Studies (interviews with teachers, students and an SLT; observation of PD lesson). Follow up collection of Pampaka scale with case study classes. |
| February | Observe fifth training session |
| Early March 2018 | Endpoint survey with teachers (including follow up transmissionist questions) |
| Early April 2018 | Report findings to EEF as to whether the intervention is ready for trial |